

2

6677 Mechanics M1 – January 2001

1. (a) 50 N (b) 1.9 cm
2. (a) 53° (b) 25
3. (a) $\frac{21}{5}mg$ (c) 7
4. (a) $(2\mathbf{i} + \mathbf{j}) \text{ m s}^{-1}$ (b) 26.6° (c) 12.6 m
5. (a) 4.2 m s^{-1} (b) 1.44 N s (c) 0.45
6. (b) 19.6 m s^{-1} (c) 78.6 m (d) 18.6 s
7. (a) 509.4 N (b) 1.5 m s^{-2}

3

6677 Mechanics M1 – June 2001

1. (a) 1.75 m s^{-1} (b) 0.75 Ns
2. (a) 7.55 N (b) 14.8°
3. (a) 138.5 m (c) 5200 N
4. (b) 40 N (c) 0.28
5. (a) 0 (b) 3750 N (c) 3125 N (d) 1.6 m
6. (a) 0.4 m s^{-2} (b) 0.09 m s^{-2} , decreasing
7. (a) $6\mathbf{i} + 8\mathbf{j}$ (b) 2 hours
(c) $6\mathbf{i} - 4\mathbf{j}$ (d) 159.4°

4

6677 Mechanics M1 – January 2002

1. 1.8
2. (a) 3 m s^{-2} (b) 18.3 m s^{-1}
3. (a) $\frac{5a}{6}$ (b) 35.5°
4. (i) 8.82 N (ii) 7.35 N
5. (a) (i) $2u, 5u$ (b) $6mu^2$
6. (a) 6.4 m (b) 2 s (c) 63.4 m
7. (b) $\frac{1}{4} \text{ m s}^{-2}$ (b) 19.1 N (c) 25.5 N (d) 0.14
8. (a) $(6 - 3t^2)\mathbf{i} + (6t - 8)\mathbf{j}$ (b) 7.8 J (c) $\frac{4}{3} \text{ s}$ (d) 4.02 N
9. (a) 18816 J (b) 313.6 N (c) 12.5 m s^{-1} (d) $80\mu\text{g N}$ (e) $64\mu\text{g}$
(f) 0.46

5

6677 Mechanics M1 – June 2002

1. (a) 3.75 m s^{-2} (b) $116\frac{2}{3} \text{ m}$
2. (a) 2.2 m s^{-1} (b) 0.9 kg or 1.8 kg
3. (a) 6.5 N (b) 55 cm
4. (a) 88.3 N (b) 74.7 N
5. (a) 153.4° (b) $(2\mathbf{i} - 3\mathbf{j}) \text{ m s}^{-2}$ (c) 7.21 N
(d) $\mathbf{v} = (-5 + 2t)\mathbf{i} + (7 - 3t)\mathbf{j}$ (e) 2.4 s
6. (b) 7 s (d) 2360 N (e) 688 N
7. (b) $\frac{7}{6}h$

6

6677 Mechanics M1 – November 2002

1. (a) $T = 6.93$ (b) $F = 3.46$
2. (a) 5.39 (b) $10\mathbf{i} - 17\mathbf{j}$
3. (b) $T = 8$ (b) 2.5 m s^{-1}
4. (a) $x = 3$ (c) $AD = 1.2 \text{ m}$
5. (a) $a = (-)3.6 \text{ m s}^{-2}$ (b) $\mu = 0.755$ (c) $AC = 13.9 \text{ m}$
6. (b) $AB = 24 \text{ m}$ (c) 79.2 m
7. (a) $60\mathbf{i} - 120\mathbf{j}$ (b) $\mathbf{p} = 20\mathbf{i} + 35\mathbf{j} + (60\mathbf{i} - 120\mathbf{j})t$
(c) $\mathbf{q} = 96t\mathbf{i} - 72t\mathbf{j}$ (d) $PQ \approx 80 \text{ km}$
8. (a) $T = 17.6 \text{ N}$ (b) $m = 2$ (c) 4.2 Ns
(d) 0.286 s

7

6677 Mechanics M1 – January 2003

1. (a) $v = 2.5 \text{ m s}^{-1}$ (b) 15 000 Ns
2. (a) $\theta = 138.2^\circ$, (b) $X = 8.94$
3. (a) $(-5\mathbf{i} + 12\mathbf{j}) \text{ m s}^{-2}$ (b) 5.2 N
4. (a) $\mathbf{p} = 10t\mathbf{j}$; $\mathbf{q} = (6\mathbf{i} + 12\mathbf{j}) + (-8\mathbf{i} + 6\mathbf{j})t$ (b) 18 km (c) $\frac{3}{4}$
5. $T = 11.0 \text{ N}$
6. (b) $x < 1$
7. (b) $T = 4.64 \text{ s}$ (c) $F = 6390 \text{ N}$
(d) Air resistance; variable F
8. (a) $T = 4.7 \text{ N}$ (b) $t = 0.452 \text{ s}$ (c) $t = 0.485$

8

6677 Mechanics M1 – June 2003

1. (a) 588 N (b) $\frac{5}{4}$ m
2. (a) 0.36 Ns (b) 2.7 ms^{-1} (c) 0.216 Ns
3. (a) 10.7 ms^{-1} (b) 1.5 s
(c) Air resistance; 'spin', height of diver; hit board again or horizontal caption of velocity.
4. 0.26
5. (a) $2\frac{1}{3}$ s (b) 4.47 ms^{-1} (c) 117°
6. (a) 10.2 N (b) 2.2 m
7. (b) 98 s
8. (a) 0.7 ms^{-2} (b) 960 N

9

6677 Mechanics M1 – November 2003

1. (a) $u = 28 \text{ m s}^{-1}$ (b) $t = 5.7 \text{ s}$
2. (a) 2.4 m s^{-1} (b) due west (c) 3000 kg
3. 520 (or 519) N
4. (b) $T = 200 \text{ s}$ (c) $t = 60 \text{ s}$ (d) $v = 50 \text{ m s}^{-1}$
5. (a) $a = -2\mathbf{i} + 4\mathbf{j}$ (b) $\mathbf{F} \approx 13.4 \text{ N}$ (c) 35 m
6. (b) $200x + W = 675$ (c) $x = 3.1 \text{ m}$; $W = 55 \text{ N}$
7. (a) $0.4g - T = 0.4 \times \frac{1}{5}g$ (b) $T = 3.14 \text{ N}$
(e) 1.98 m s^{-1}

10

6677 Mechanics M1 – January 2004

1. (a) $m = 840 \text{ kg}$ (b) $2\,100 \text{ Ns}$
2. (a) 200 N (b) 14 cm
3. (a) 1.5 m s^{-2} (b) 3 m s^{-2} (c) 1.5 m s^{-2}
4. (b) $\frac{4}{7}$
5. (a) 25.2 N (b) 44 N
6. (c) 564 m (d) 76.2 s
7. (a) 0.31° (b) $\mathbf{a} = 9t\mathbf{j}$; $\mathbf{b} = (-10 + 3t)\mathbf{i} + 5t\mathbf{j}$ (e) 1424 hours

11

6677 Mechanics M1 – June 2004

1. (a) 86.6 N (b) 100 N
2. (b) (-2 m s^{-1}) in direction of CA
3. (b) 20 m s^{-1}
4. (a) 131 N (b) 163 N (c) 0.5 m
5. (a) 257 N (b) 12.5 s
6. (a) 117° (b) $(4\mathbf{i} - 6\mathbf{j}) + t(4\mathbf{i} - 2\mathbf{j})$ (c) $p = 36, q = -34$
7. (b) 16 N (e) 20 m s^{-1}

12

6677 Mechanics M1 – November 2004

1. (b) $t = 18 \text{ s}$
2. (a) 16.8 N (b) $m = 1.2$
3. (a) 10.9 N (b) $m = 4.44 \text{ kg}$
4. (a) $v = 15 \text{ m s}^{-1}$ (b) $R = 991$
5. (a) 146° (b) $\mathbf{v} = (2 - t)\mathbf{i} + (-3 + 2t)\mathbf{j}$ (c) 3.16 m s^{-1}
(d) $t = 1.5 \text{ s}$
6. (a) $v = 32 \text{ m s}^{-1}$ (b) 90 m (c) $t = 5 \text{ s}$
7. (a) $R = 243 \text{ N}$ (b) $a = 3.08 \text{ m s}^{-2}$ (c) $s = 36.7 \text{ m}$
8. (a) $T = 131 \text{ N}$ (b) 209 N
(c) (i) Friction acts down slope (and has magnitude $0.4R$)
(ii) Net force on package = 0 (or equivalent)

13

6677 Mechanics M1 – January 2005

1. (a) -0.7 m s^{-1} (b) Direction of Q unchanged (c) 8.25 N s
2. (a) 45 g (441 N) (b) 0.33 m
3. (a) 162 m (b) 6.2 m s^{-1} (c) -0.56 m s^{-2}
4. (a) 23 N (b) 17.6 N
5. (a) 3.2 m s^{-2} (b) 5.28 N (c) 0.75
(d) Same acceleration for A and B .
6. (a) 3 m s^{-2} (b) 14.8 m s^{-1} (d) 3.06 s
7. (a) $(3\mathbf{i} + 8\mathbf{j}) \text{ m s}^{-1}$
(b) $\mathbf{p} = (20\mathbf{i} + 10\mathbf{j}) + (3\mathbf{i} + 8\mathbf{j})t$, $\mathbf{q} = (14\mathbf{i} - 6\mathbf{j}) + 12t\mathbf{j}$
(d) 161 mins or 2 hrs 41 mins

14

6677 Mechanics M1 – June 2005

1. (a) 3.6 m s^{-2} (b) 440 m
2. (a) 4.4 m s^{-1} (b) 2.16 Ns
3. (a) 7.5 N (c) 12 N
4. (a) 18 N (b) 0.12 m s^{-2}
5. (b) 78 m (c) 35 s
6. (a) $9g$ or 88.2 N (b) 0.875 m
7. (a) 0.24 m s^{-2} (b) 534 N (c) 54 m
8. (a) 9.43 m s^{-1} (b) $(2\mathbf{i} + \mathbf{j}) + (5\mathbf{i} + 8\mathbf{j})t$ (c) 1.6s
(d) 4.25 m s^{-1}

15

6677 Mechanics M1 – January 2006

1. (a) 14.4 m (b) 23.2 m s^{-1}
2. (a) 3 m s^{-1} (b) (i) 3.6 (ii) 18 Ns
3. (a) 1.25 m (c) 0.4 m
4. (a) 14.8 N (b) 144°
5. (a) 18.7 N (b) 0.62 (c) Does not slide
6. (a) 6.08 m s^{-1} (b) 351 (d) 21 m
7. (a) $\frac{6}{5} mg$ (b) 0.693 (c) $\frac{6}{5} mg$

16

6677 Mechanics M1 – June 2006

1. (c) 30.5 m
2. (a) 2.25 m s^{-1} (b) 1.5 Ns
3. (a) 2.5 m s^{-2} (b) 31.7 m s^{-1} (c) 1.69 s
4. (a) 0.27 (b) 3.76 m s^{-2}
5. (a) 70 N (c) 30
6. (a) 0.7 m s^{-2} (b) 770 N (c) 58 m
7. (a) 6.5 km h^{-1} (b) 337 (c) $8.5\mathbf{i} + 23\mathbf{j}$
(d) $11\mathbf{i} + (17 + 5t)\mathbf{j}$ (e) 1512 hours (f) 4.72 km

17

6677 Mechanics M1 – January 2007

1. (a) 48 (b) 41.6
2. (b) 24 N (c) 144 N
3. (a) $3\mathbf{i} - 1.5\mathbf{j}$ (b) 6.71 N (c) $21\mathbf{i} - 7\mathbf{j} \text{ m s}^{-1}$
4. (a) $u = 8$ (b) 3 N s (c) $R = 2$
5. (a) 22.5 N (b) 22 m s^{-1} (c) 4.4 s
6. (a) 110 N (b) 1.5 m s^{-2}
7. (a) $T - 3g \sin 30^\circ = 3a$, $2g - T = 2a$ (c) 18 N
(e) 1.3 m s^{-1} (f) 0.51 s

18

6677 Mechanics M1 – June 2007

1. (a) $T \approx 35.1 \text{ N}$ (b) $T \approx 33.0 \text{ N}$
2. (a) 3 Ns (b) $m = 0.5$
3. (b) $AD = 0.6 \text{ m}$
4. (b) $V = 11$ (c) $a = 1.75 \text{ m s}^{-2}$
5. (a) $R = 1.7 \text{ N}$ (b) $\mu \approx 0.55$
6. (b) $T = 3.5 \text{ N}$
(d) The acceleration of P is equal to the acceleration of Q .
(e) $t = 0.857$
7. (a) $\mathbf{v} = 2\mathbf{i} + 6\mathbf{j}$ (b) $\mathbf{b} = 3\mathbf{i} - 4\mathbf{j} + (2\mathbf{i} + 6\mathbf{j})t$
(c) $\lambda = -2$

19

6677 Mechanics M1 – January 2008

1. (a) 3.2 (b) $m = 3.2$
2. (a) $a = 6$ (b) 18 m s^{-1} (c) 43.4 m
3. (b) 50s (c) $V = 28$
4. (b) 90.1 N (c) 2.2 m s^{-2}
5. (a) (i) 73.5 N (ii) 44.1 N (b) $4gy + 7.5g$
(c) $y \leq \frac{5}{8}$
6. (a) 9.43 m s^{-1} (b) 328° (c) $u = 2, v = -3.5$
(d) 10.5 s
7. (a) $\frac{10}{9}mg$ (c) $v = \frac{2}{3}\sqrt{gh}$

20

6677 Mechanics M1 – June 2008

1. (a) $v = 7.5 \text{ m s}^{-1}$
2. (a) $u = 10.5$ (b) $T = 2\frac{6}{7}$
3. (a) 53° (b) 4 (c) $39\mathbf{i} + 30\mathbf{j} \text{ m s}^{-1}$
4. (b) 1.875 m s^{-1}
5. (a) 9.79 N (b) 19.3 N
6. (a) 85 N (b) 1.4 m
7. (a) 68 (b) 0.14
8. (a) $1\frac{1}{3} \text{ m s}^{-2}$ (b) $\frac{10}{21}$ (c) 12 N (e) $\frac{6}{7} \text{ s}$

21

6677 Mechanics M1 – January 2009

1. $u = 20$
2. (a) $u = 19.6$
3. (a) $v = u(3k - 4)$ (b) reversed (c) $7mu$
4. (a) $C = 90\text{g}$, $D = 30\text{g}$ (b) 1.07m
5. (b) (i) 9.8 N (ii) 1.96
6. (a) 153.4° (c) $m = \frac{1}{4}$
7. (a) (i) $a = 0.6\text{g}$, $T = 6\text{g}$ (b) $N = 2\text{g}$ (c) 105 N

22

6677 Mechanics M1 – June 2009

1. (i) 20 (ii) 2.5
2. (a) 26.6° (b) $\frac{3}{2}$
3. (a) $v_A = \frac{u}{4}$ (b) $v_B = \frac{u}{2}$
4. 5.9 m s^{-2}
5. 37
6. (a) 0.6 m s^{-2} (b) 320 N (c) 900
7. (b) $T_Q = 98 + 350x$ (c) $98 < T_P < 588$ and $98 < T_Q < 588$
(d) $x = 1.19$
8. (a) 1.5 m s^{-1} (b) $(\mathbf{r}_H =) 100\mathbf{j} + t(1.2\mathbf{i} - 0.9\mathbf{j}) \text{ m}$

23

6677 Mechanics M1 – January 2010

1. (a) 18 Ns (b) $m = 1.5$
2. (b) $T = 50$
3. (a) $T = 20\sqrt{3}$ (b) $m = \frac{40}{g}$
4. (b) $\frac{1}{6}W - \frac{40}{3}$ (c) $W = 280$
5. (a) 0.6 m s^{-1} (b) $\mu = 0.51$ (c) $X = 12$
6. (b) $k = 3$ (d) 3.969 m
7. (a) 5 km h^{-1} (b) 36.9° (d) $T = 1, 5$

24

6677 Mechanics M1 – June 2010

1. 17 m
2. (a) $k = \frac{4}{3}$ (b) $6mu$
3. 12.6 kg
4. 1.2 m
5. (b) $T = 9$
6. (a) 60 m (b) 34 m s^{-1} (c) 5 s
7. (b) $\frac{2}{3} \text{ g}$ (6.53) (b) $P = \frac{26}{45} \text{ g}$ (5.66)
8. (a) 3.36 N (b) 1.4 m s^{-2} (c) 0.57 s

25

6677 Mechanics M1 – January 2011

1. (a) $m = 5$ (b) 15 N s
2. (b) 0.041 m (c) $h = 2.1$
3. (a) 118 N, 78.4 N (b) $AD = 3.83 \text{ m}$
4. (a) 5.39 m s^{-1} (b) $\mathbf{F} = 2\mathbf{i} + 6\mathbf{j}$ (c) $t = 1.667 \text{ s}$
5. (b) $v = 16$
6. (b) 120 N (c) 42 N acting up the plane
7. (a) 3.92 m s^{-2} (b) 2.8 m s^{-1} (c) $\frac{2}{7} \text{ s}$

26

6677 Mechanics M1 – June 2011

1. (b) 1.7 s, 4 s
2. (a) 0.6 m s^{-1} , 1.6 m s^{-1} (b) 7.2 Ns
3. (ii) 22 N
4. (b) 310 m (c) 4 (d) 0.05 m s^{-2}
5. (a) (i) 310 N (ii) 4
6. (a) 2.4 (b) 0.4 (c) 0.071 s
7. (a) 37° (b) (i) $(\mathbf{i} + \mathbf{j}) + t(2\mathbf{i} - 3\mathbf{j})$ (ii) $(-2\mathbf{j}) + t(3\mathbf{i} + 4\mathbf{j})$
(iii) $(-\mathbf{i} - 3\mathbf{j}) + t(\mathbf{i} + 7\mathbf{j})$ (c) (i) 3 p.m. (ii) 2. 30 p.m.

27

6677 Mechanics M1 – January 2012

1. (a) 27 000 N s (b) $m = 1500$
2. (b) 1520 N
3. (a) $p = -12$, $q = 3$ (b) $3\sqrt{17} \text{ N}$ (c) 104°
4. (b) $\frac{17}{12}mg$
5. (b) 15.6 m (c) 2.71 s
6. (a) 6 s (c) 48 (d) $\frac{15}{16}$
7. (a) 8.9 km h^{-1} (b) $\mathbf{p} = (2\mathbf{i} - 8\mathbf{j}) + t(-4\mathbf{i} + 8\mathbf{j})$
(c) $\frac{5}{4}$ (d) 13.5 km
8. (a) 15.9 (b) 0.73 (c) 11.6 m

28

6677 Mechanics M1 – June 2012

1. (a) 1.6 m s^{-1} (b) $m = 0.3$
2. (a) 14.7 N (b) $AG = \frac{4}{3} \text{ m}$
3. (a) 52.4 N (b) $\mu = 0.137$
4. (b) 30 s (c) 155 s
5. (b) $t = 3.0 \text{ or } 1.3$ (c) 0.316 m
6. (a) 302° (b) $\mathbf{s} = 40\mathbf{i} - 6\mathbf{j} + t(-12\mathbf{i} + 7.5\mathbf{j})$ (c) 5 km
(d) $2\frac{1}{8} \text{ km}$
7. (a) 1.25 m s^{-2} (b) 7.5 m s^{-1} (c) 1.375 N
(d) 7.5 m (e) 0.125 N

29

6677 Mechanics M1 – January 2013

1. (a) $v = 5u$, opposite direction (b) $10mu$
2. (a) $160g, 1600, 1570$ (b) $140g, 1400, 1370$ (c) $x = \frac{22}{7}$
3. (i) $F = g = 9.8$ (ii) $T = \sqrt{3}g = 17.0$
4. $\mu = 0.1$
5. (a) $a = 1.5$ (b) $T = 28$ (d) $V = \frac{125}{3}$
6. (a) 10 km h^{-1} (c) $L = -9\mathbf{i}$
7. (a) Inextensible string (b) $T - 2mg \sin a - F = 2ma$
(c) $a = 0.4g = 3.92$ (d) $XY = 1.5h$

30

6677 Mechanics M1 – June 2013

1. (a) $I = 9 \text{ Ns}$ (b) $m = 2$
2. (a) $T = 7800 \text{ N}$ (b) $R = 390 \text{ N}$
3. $T = 1.6g$
4. (a) $u = 14$ (b) $t = 6$
5. (b) $T = 75$ (c) 50 s (d) $a = 0.79$
6. (a)(i) $M = 25 \text{ kg}$ (a)(ii) $x = 6 \text{ m}$
(b) $AX = 7.5 \text{ m}$
7. (a) $\sqrt{10}$ (b) 315°
(c)(i) $t = 0.5$ (c)(ii) $t = \frac{2}{3}$
8. (a) 5.88 m s^{-2} (b) $T = 11.8m$ (c) $F = 16.6m$

31

6677 Mechanics M1 – June 2013 (R)

1. (a) $v = 2 \text{ m s}^{-1}$ (b) $w = \frac{4}{3} \text{ m s}^{-1}$
2. (i) $T_A = 8.37 \text{ N}$ (ii) $T_B = 7.57 \text{ N}$
3. $T = \frac{8g}{3} \text{ N}$
4. (a) $T = \frac{50}{18}$ (b) $h = 17.74$
5. (a) $v = 3.71 \text{ m s}^{-1}$ (b) $a = 0.490 \text{ m s}^{-2}$ (c) $\mu = 0.41$
6. (a) $(-4 + 3t)\mathbf{i} + (2 + 3t)\mathbf{j}$ (b) $n = 3.5$
(c) $OP = 8.25 \text{ km}$
7. (a) 1.02 m s^{-2} (b) $\frac{1550}{3} \text{ N}$ (c) $R = 1750 \text{ N}$
8. (a) $x = 0.6$ (b) $m = \frac{400}{17}$