Leaving Certificate Applied Maths Higher Level Answers

2018

1) (b) (ii) $\frac{3u^2}{2a}$. 2) (a) (i) 6.1° E of N, (ii) 118.4 km. (b) (i) 60 s, (ii) 240 m. 3) (a) (ii) 62.5 m.

3) (b) (i) $\frac{4u\sin\theta}{\sqrt{3}g}$, $\frac{4u\sin\alpha}{\sqrt{3}g}$, (ii) $\frac{2u^2}{3g}\left(\sqrt{3}-1\right)$. 4) (a) (i) $\frac{g}{m+3}$ m s^{-2}, (ii) 2 kg. (b) (ii) $\frac{8mg}{8+m}$, (iii) 8 kg.

5) (a) (i) $\frac{u}{2}(3-7e)$, $\frac{u}{2}(3+7e)$. (b) (i) $\frac{u}{5}\sqrt{4\cos^2\alpha+400\sin^2\alpha}$, $\frac{u}{5}\sqrt{49\cos^2\alpha+25\sin^2\alpha}$, (ii) 38.7°.

6) (a) (i) 3.7 m. (b) (ii) 7. 7) (a) 60°. 8) (b) (ii) $\frac{55mr^2}{96}$, (iii) 2.52. 9) (a) 68.375%. (b) ½.

10) (a) 0.63. (b) (i) $40n+(P-40n)e^{-t/40}$, (ii) 5 years.

2017

1) (a) 2. (b) (i) $\sqrt{2gr}$, (ii) $\frac{d}{\mu}$, (iii) 5 m. 2) (a) 4.07 m s^{-1}, 79.4° N of E.

2) (b) (i) 15 km h^{-1}, 30° S of E, (ii) 35.7°, (iii) 9.04 km. 3) (a) (i) 0°, 71.6°, (ii) $\sqrt{\frac{2h}{g}}$ s, $\sqrt{\frac{20h}{g}}$ s.

4) (a) (i) $\frac{8mg}{5}$ N, (ii) 0.0136 m, (iii) $\frac{6mg}{5}$ N. (b) (ii) $\frac{1}{5}$. 5) (a) (i) $\frac{12}{7}$ m s^{-1}, (ii) $\frac{6}{7}$. (b) (i) $\frac{70v}{27\cos\alpha}$, (ii) 50.2°.

6) (a) $1:\sqrt{2}$. (b) (ii) $\frac{mg}{2}$, $2mg$. 7) (a) $\sqrt{39}$ N @ 73.9°, $\sqrt{3}$ N $\rightarrow$. 8) (b) (i) $69ma^2$, (iii) 120°.

9) (a) 19.5 cm^3. (b) (i) 0.0574 m, (ii) 997 cm^3. 10) (a) (i) $\frac{5}{2}\left(1-e^{-10t}\right)$, (ii) 0.23 s, 0.35 m. (b) (ii) $\sqrt{\frac{8gR}{5}}$.

2016

1) (a) (ii) 5 m s^{-1}, (iii) 107.5 m. 2) (a) (i) 11.5 km h^{-1}, (ii) 17.1° E of N, 72.9° E of N. (b) (i) 150 s, (ii) 187.5 s.
3) (a) (i) 1 s, (ii) 0.65 m, (iii) 30.9 m s^{-1}. (b) 0.5. 4) (a) (i) 1.92 m s^{-2}, 3.84 m s^{-2}, (ii) 1.07 m s^{-1}.
4) (b) (i) 62.4 N, (ii) 0.90 s. 5) (a) (ii) 0.22 m s^{-1}, 3.10 m s^{-1}, (iii) 41°. (b) (i) $3\vec{i}+2\vec{j}$, $2\vec{i}-2\vec{j}$, (ii) 52°.
6) (a) (i) 9.90 m s^{-1}, (ii) 80.4°. (b) (ii) 2.42 m s^{-1}, (iii) 0.55 s. 8) (b) (i) 1.488 kg m^2, (ii) 117.9 J, (iii) 11.35 m.
9) (a) $h=\frac{4M}{\rho\pi d^2}$. (b) $1-\sqrt{1-s}$. 10) (a) (ii) 40.7 m. (b) (i) $v=\omega\sqrt{A^2-x^2}$, (ii) $x=A\sin\left(\omega t+\frac{\pi}{2}\right)$.

2015

1) (a) 57 m. (b) (i) 3.5 s, (ii) 48.86 m. 2) (a) (i) 97.2 km h^{-1}, 19.1° N of W, (ii) 655 m. (b) (i) 8.20 m s^{-1}, 19.5°.
3) (a) (i) 27.7 or -0.125, (ii) 10.1 s or 0.373 s, (iii) 0.21 m. 4) (a) (i) 2.94 m s^{-2}, (ii) 4.2 m s^{-1}, (iii) 3 m s^{-1}.
4) (b) (i) 2.00 m s^{-2}, (ii) 220.5 N. 5) (a) (ii) $\frac{19}{80u}$. 6) (a) (i) $\frac{mg}{d}$, (ii) $2\pi\sqrt{\frac{d}{g}}$. (b) 21.6°.

7) (a) (i) $\frac{3W\sqrt{c^2+l^2}}{2c}$, (ii) $\frac{W}{2c}\sqrt{9l^2+c^2}$. (b) (i) $\frac{7W}{4}$, $\frac{5W}{4}$, (iii) 0.6. 8) (b) (i) $x+\frac{1}{12x}$, (ii) $\frac{1}{2\sqrt{3}}$ m, (iii) 1.53 s.
9) (a) 8676 kg m^{-3}. (b) (i) 482.8125, (ii) 0.1627 m.
10) (a) (i) 16 m s^{-1}, (ii) 16 m. (b) (i) $F+74x+0.55x^2+0.01x^3$, (ii) 32,800, (iii) 2,695.

2014

1) (a) (i) $24-\frac{1}{2}t^2$, (ii) 18.375 m. (b) (i) 0.527 m s^{-2}, (ii) 23.74 m s^{-1}. 2) (a) (i) 18:00, (ii) 18:51.

2) (b) (i) 25 km hr^{-1}, 73.74°, (ii) 91 km. 3) (a) 28.15 m s^{-1}. 4) (a) (i) 3.91 m s^{-2}, (ii) 140.96 N. (b) (ii) $\sqrt{\frac{7}{10g}}$ s, 0.22 m.

5) (a) (ii) $\frac{7}{8}mu^2$. (b) (i) 0.484, (ii) 6.93. 6) (a) (i) 3158.27 N m^{-1}, (ii) 47.4 N. (b) (i) $4.233\sqrt{d}$, (ii) 4.06m.

7) (a) (i) 12.75 cm, 14.75 cm, (ii) 26.79°. (b) (ii) 0.62, (iii) 73.4 N, 10.0°. 8) (b) (i) $2\pi\sqrt{\frac{3r}{2g}}$, (ii) 15.

9) (a) 3200 kg m^{-3}, 4800 kg m^{-3}. (b) (i) 45.2, (ii) 160 N, (iii) 428.6 kg m^{-3}.
10) (a) (i) 4.225 m s^{-1}, (ii) 0.33 m. (b) (i) 1 s, 2 s, (ii) $\frac{1}{3}t^3-\frac{3}{2}t^2+2t+1$, (iii) 1 m.

2013

1) (a) 7 s. 2) (a) (i) 36 m, (ii) 53.13°. (b) W 60° S. 3) (a) (ii) 30°. (b) 31.7°.

4) (a) (i) $\frac{84g}{13}$ N, (ii) $\frac{189g}{26}$ N. (b) $\frac{4m_1m_2m_3g}{m_1m_3+m_2m_3+4m_1m_2}$. 5) (a) (i) $\frac{u}{8}(3-5e)$, $\frac{3u}{8}(1+e)$, (ii) $\frac{1}{15}$.

5) (b) (i) $\frac{1}{2}$, (ii) $\frac{1}{3}$, (iii) 3.33 cm. 6) (a) (i) 0.49, (ii) $\frac{\pi}{\sqrt{5}}$ s. (b) (i) $m\left(l\omega^2+g\right)$, $m\left(l\omega^2-g\right)$, (ii) $\sqrt{\frac{6l}{g}}$.

7) (a) 62.18°. (b) (i) $\frac{W(4-b)}{2}$, $\frac{W(2+b)}{2}$. 8) (b) (i) $2\pi\sqrt{\frac{5r}{3g}}$, (ii) $\frac{5r}{3}$.

9) (a) 0.0001 m^3, 0.0004 m^3. (b) 400. 10) (a) 1.5, (b) (i) 60 m s^{-1}, 36 m, (ii) $\frac{10}{3}$ s. (c) 79.3 mins.

2012

1) (a) 44.1 m. (b) (i) 40 s, (ii) 352 m. 2) (a) 82.55°. (b) (i) 25 km hr^{-1} at 16.3° E of N, (ii) 13:21, (iii) 1 hr 9 min.

3) (a) (i) 36.9° & 53.1°, (ii) 4 s. (b) (i) 60°, (ii) 70 m s^{-1}. 4) (a) (i) $\sqrt{\frac{2g}{13}}$, (ii) $\frac{1}{11}$ m. (b) (i) $\frac{4mg(1+\mu)}{5}$, (ii) $3f-2g$.

6) (a) (i) $\frac{\pi^2}{5}$ m s^{-1}, (ii) 5.9 N. (b) (i) 1.4 m s^{-1}, (ii) 0.93. 7) (a) 1.316. 8) (b) (i) $\frac{mgI}{I+mr^2}$, (ii) $8m$.

9) (a) 7.79. (b) (i) 1.2 m, (ii) 60°. 10) (a) (i) 0.0405, (ii) 41.8°.

2011

1) (a) $\frac{7}{8}$ s. (b) (ii) $t_1+t_2=t$, (iii) $\frac{31}{12}t$. 2) (a) (i) $\sqrt{65}$ m s^{-1} at 82.9° S of W, (ii) 49.6 m. (b) $28.955^\circ \le \theta \le 60^\circ$.

3) (a) (i) 50, (ii) 71.6°. (b) (i) 56.3°, (ii) $\frac{1}{\sqrt{2}}$. 4) (a) 2.15 m s^{-2}. (b)73 N, 21.9 N, 24 N.

5) (a) (ii) ¼ < e < 1. (b) (i) $\frac{1-e}{2}$, (ii) ¾. 6) (a) (ii) 2.6 m, 4 rad s^{-1}, 0.395 rad. (b) 7 rad s^{-1}. 7) (a) (ii) 2800 N m^{-1}.

8) (b) (i) 3.19 rad s^{-1}, (ii) 1.74 s, 0.75 m. 9) (a) 2.88 x 10^{-6} m^3. (b) $\frac{3}{7}$. 10) (a) 66.23. (b) (i) 44.63 m, (ii) 19.24 m s^{-1}.

2010

1) (a) (i) -1 m s^{-2}, (ii) $-\frac{7}{6}$ m s^{-2}. (b) 300 m. 2) (a) (i) $\sqrt{17}$ m s^{-1} at 75.58° S of E. (b) 12.5 m s^{-1} from East.

3) (a) $4.9\sqrt{5}$ m. (b) (i) 23.4°, (ii) $20\sqrt{7}$ m s^{-1}. 4) (a) (i)2.4 N, (ii)0.8 m s^{-1}. (b) (ii) $\frac{3}{11}g$ m s^{-2}.

5) (a) (i) $\frac{u(1-3e)}{4}$, $\frac{u(1+e)}{4}$, (ii) 70.3%. (b) (i) $\frac{3+k}{2+4k}$. 6) (a) (i) $\sqrt{\frac{4g}{3}}$ m s^{-1}, (ii) $\sqrt{8g}$ m s^{-1}.

6) (b) (i) $\frac{3\pi}{8}$ m s^{-1}, (ii) ⅔ s. 7) (b) (ii) $\frac{5}{4}W$, (iii) $2W$. 8) (b) (ii) $\sqrt{\frac{ga}{3a^2+b^2}}$. 9) (a) 1250 kg m^{-3}.

9) (b) (i) $\frac{5}{9}$, (ii) $\frac{2}{5}W$. 10) (a) $y=\sqrt{e^{x^2}-1}$. (b) (i)5.18 m s^{-1}, (ii) 45.3 s.

2009

1) (b) (ii) 1. 2) (a) (i) 160 m, (ii) 128 m, 96 m. (b) $\frac{uT}{\sqrt{u^2-16}+4}$. 3) (a) (i) $\frac{10\sqrt{10}}{7\cos\alpha}$ s.

4) (a) (i) $\sqrt{\frac{2g}{3}}$ m/s, (ii) $\frac{4}{3}$ m. (b) (i) $\frac{3m_1m_2g}{4m_1+m_2+m_1m_2}$ N, (ii) 1. 5) (a) (i) $\frac{u(4-2e)}{3}$, $\frac{u(4+e)}{3}$, (iii) ⅓.

5) (b) (ii) N, 80.1° W of N, (iii) 13.5%. 6) (a) (ii) 3.03 cm/s. (b) $\frac{900\mu g}{\pi^2N^2}$. 7) (a) 15 cm. (b) $\frac{W}{2}$.

8) (b) (i) $6ml^2$, (ii) $\sqrt{\frac{g}{\sqrt{3}l}}$. 9) (a) 8 cm. (b) (i) $1-\sqrt{1-s}$, (ii) $\frac{W}{3}$. 10) (a) $y=\sqrt{4x^2-1}$. (b) (i) $\sqrt{\frac{3g}{k}}$, (ii) $\frac{1}{g}$.

2008

1) (a) (i) 4 s, (ii) 83.3 m. (b) (i) $\frac{5}{24}$ m/s^2, $\frac{1}{2}$ m/s^2, (ii) 48 m/s, (iii) 525 m.

2) (a) (i) 2.5 m/s 53.13° S of E, (ii) 64 m. (b) from 71.6° W of N. 3) (b) 4. 4) (b) (ii) $\frac{\sqrt{3}g}{19}$.

5) (a) (i) $1-e$, $\frac{1}{2}\left(1-e^2\right)$, $\frac{1}{2}\left(1+e\right)^2$. 6) (a) (ii) 1.68 m/s, 10.8 m/s^2. (b) $\sqrt{\frac{3g}{2}}$. 7) (a) $\frac{7}{4}$. (b) $\frac{2}{3}$.

8) (b) (i) $\frac{g}{6}$, (ii) 49 N, 45.7 N. 9) (a) 1.06 m. (b) (i) 0.8, (ii) 0.147 N, (iii) 2.18 cm.

10) (a) 1. (b) (i) 3200, (ii) 15.0 m/s.

2007

1) (a) (i) 5.4 m/s, (ii) 100 m. (b) (ii) 1. 2) (a) (i) 40 km/hr 53.13° N of E, (ii) 24 mins. (b) 48.04 m. 3) (a) 15°, 75°.

4) (a) 2.15 s. (b) (ii) $T=\frac{48mg}{5m+48}$. 5) (a) (i) $v_1=6-3e$, $v_2=6+2e$. (b) (i) $u\sin\alpha$, $\frac{1}{2}u\cos\alpha$, (ii) $90-\alpha$,

5) (b) (iii) $u^2\cos^2\alpha$. 6) (a) (ii) $2\pi\sqrt{\frac{d}{g}}$. 7) (a) $\frac{7W}{10\sqrt{3}}$. (b) (ii) 80g N. 8) (b) (i) $\sqrt{2}$, (ii) 5.87 m/s.

9) (a) 27.2 cm. (b) (i) 1.075, (ii) 0.032 kg. 10) (a) $y=\frac{1}{1+\cos x}$. (b) (i) 44.12 m/s, (ii) 56.57 m s^{-1}.

2006

1) (a) (ii) $d=\frac{3}{8}ft^2$. (b) (i) $15t+0.15t^2$, $10t+0.1t^2$, (ii) 6 s, (iii) 3.1 s.

2) (a) (i) 163.2 km/hr, (ii) 282.84 km/hr West. (b) (i) 8 m, 4 m, (ii) 41.41°, (iii) 5.3 m.

3) (a) (i) $\vec{r}=\left(9.8t\right)\vec{i}+\left(29.4t-\frac{1}{2}gt^2\right)\vec{j}$, $\vec{v}=\left(9.8\right)\vec{i}+\left(29.4t-gt\right)\vec{j}$, (ii) $\theta=\tan^{-1}\left(3-t\right)$, (iii) 4 s, 5 s. (b) $\frac{2u^2}{3g}$.

4) (a) (i) $\frac{g}{9}$ m/s^2, (ii) 0.30 s. (b) (iii) 30°. 5) (a) (i) $\frac{7-5e}{2}$, $\frac{7+3e}{2}$, (ii) 15. (b) (i) $\frac{u}{2}\left(1-e\right)$, $\frac{u}{2}\sqrt{e^2+2e+5}$

6) (a) (i)3.78 m/s^2, (ii) 3.24 s. (b) 0.43 m. 7) (a) (i) 163.3 N, (ii) 163.3 N, 36.87°. (b) 2λ.

8) (b) (i) 3.5 rad/s, (ii) 5.25mg N.

9) (a) (i) 0.65 cm^3, (ii) 1.6. (b) (i) $\frac{4000\pi a^3 g}{3}$ 10) (a) $y=\frac{e^{x+1}}{1+x}$. (b) (i) 0.66 m/s, (ii) 1.73 s.

2005

1) (a) (i) 33.3 m, (ii) 43.3 m. (b) (i) 39278.4 N, (ii) 0.245 m. 2) (a) $\frac{10u}{\sqrt{u^2-v^2}}$. (b) (i) $10\sqrt{2}$ m/s , (ii) 11 m.

3) (a) $\frac{3}{4}$. (b) (i) $\frac{u^2}{g\cos\beta}\sin 2\alpha-\frac{2u^2\sin\beta}{g\cos^2\beta}\sin^2\alpha$. 4) (a) (i) $\frac{10g}{3}$ N , (ii) 46.2 N.

5) (b) (i) $\frac{u}{\sqrt{2}}\sqrt{1+e^2}$, $\frac{u}{\sqrt{2}}\sqrt{1+e^2}$. 6) (a) $2\pi\sqrt{\frac{h}{g}}$. 7) (a) 180.1 N. (b) $\frac{3}{5}\tan\theta$

9) (a) (i) 45 cm^3, (ii) 0.081 kg. 10) (a) $y=xe^{x-1}$. (b) (ii) 11.76 m/s, (iii) 1945.5 J.

2004

1) (a) (ii) 25 m, 16 m. (b) (i) 1.1 m/s^2, (ii) 6°.

2) (a) (i) 35° E of N, (ii) 8.16 s. (b) (i) 8.06 m/s 82.87° S of E, (ii) 25 m, (iii) 4.6 s.

3) (a) 40 m 4) (a) (i) $\frac{1}{3}g$ m/s^2, (ii) $\frac{3v^2}{g}$. (b) (ii) $\frac{14g}{11\sqrt{2}}$ m/s^2, (iii) 0.3 m.

5) (a) (i) $\frac{u}{8}\left(3-5e\right)$, $\frac{3u}{8}\left(1+e\right)$, (ii) $e>\frac{3}{5}$. (b) (i) 60°, (ii) $\frac{1}{3}$. 6) (a) $\frac{8r}{15}$. (b) (ii) 13, $\frac{\pi}{8}$, 1.176.

7) (a) ½ l, (b) (i) $\frac{W\sqrt{3}}{4}$, (ii) 0.84W. 8) (b) (i) 1.08 J, (ii) 0.62 m.

9) (a) 8 cm. (b) (i) $\frac{1}{3}$, (ii) $\frac{W}{2}$. 10) (a) $y=e^{-\frac{1}{x}+1}+4$. (b) (ii) $\frac{2}{g}$.

2003

1) (a) (ii) 51 m. (b) (i) 4 m/s. 2) (a) $10\sqrt{5}$ km/h, W26.6°S. (b) (i) 9.01 m/s, 73.9° S of E, (ii) 288 m, 115 m.

3) (a) 38.7°. (b) $\frac{u^2}{g\cos^2\beta}\{\sin(2\alpha-\beta)-\sin\beta\}$. 4) (a) $\frac{g}{2}$ m/s^2. (b) (ii) 1.65 m.

5) (a) (i) $\frac{u}{16}(3-13e)$, $\frac{3u}{16}(1+e)$, (ii) $0\le e<\frac{1}{3}$. (b) (ii) ½. 6) (a) (i) 4 cm, (ii) $2\sqrt{7}$ cm/s. (b) (ii) 63.6°.

7) (a) (iii) $\frac{3}{5}$. 8) (b) (i) $2\pi\sqrt{\frac{\sqrt{3}l}{g}}$, (ii) $\sqrt{3}l$. 9) (a) (iii) $150\sqrt{10}g$ N. (b) 12 cm.

10) (a) $y=\left(2x^2-3\right)^{\frac{1}{4}}$. (b) (ii) 1.65 s.

2002

1) (a) (i) 18.5 m/s, (ii) 30.5 m/s. 2) (a) (i) 8660 m, (ii) 1960 s. (b) 26 km/hr, 61° N of E.

3) (a) (ii) 45°. 4) (a) 7 cm. (b) (i) $\frac{3g}{4}$, (ii) 3 N. 5) (a) 0.58. 8) (b) (ii) $14960\pi^2$ J.

9) (a) $\frac{8}{17}$. (b) $\frac{8}{25}$. 10) (a) $y=\ln(e^x+3)$. (b) (i) $\ln 3$ s or 1.1 s, (ii) 63.63 m, (iii) 100 m/s.

2001

1) (a) 75 s, 60 s. 2) (b) 388 km. 3) (a) 14.7 m/s. (b) $\frac{3h}{2}$.

4) (ii) $\frac{7g}{13}$ m/s^2, $\frac{3g}{13}$ m/s^2, $\frac{2g}{13}$ m/s^2, $\frac{2g}{13}$ m/s^2, (iii) $\frac{2}{3}$ m. 5) (a) (i) $\frac{u}{5\sqrt{2}}\sqrt{29-12e+9e^2}$, $\frac{\sqrt{2}u}{5}(1+e)$.

6) (a) (i) $A=\sqrt{\frac{52}{3}}$ cm, $T=\frac{2\pi}{\sqrt{3}}$, (ii) $2\sqrt{13}$ cm/s. (b) (i) $\frac{5l}{4}$, (ii) $\frac{\pi}{3}\sqrt{\frac{l}{g}}$. 7) (b) $4W$.

8) (b) $\frac{5}{4}mr^2$, $\omega=\sqrt{\frac{8g\sin\vartheta}{5r}}$, $\omega_{\max}=\sqrt{\frac{8g}{5r}}$. 9) (a) 0.0014 m^3, 0.0002 m^3.

10) (a) $\frac{d}{dx}\left(\frac{y}{x}\right)=\frac{1}{x}\frac{dy}{dx}-\frac{y}{x^2}$, $y=x(1+\ln x)$.

2000

1) (a) 56 m/s. (b) (i) 215 s, 4875 m, 5125 m, (ii) q, 10 s. 2) 30°, $\frac{4a}{u\sqrt{3}}$, (i) a, (ii) $\frac{7a}{\sqrt{3}}$, $\frac{5a}{\sqrt{3}}$.

3) (a) 45°. (b) 26.6° or 45°. 4) (a) 4.9 m. (b) (iii) $3\sqrt{2}$ m/s.

6) (a) $2\sqrt{g}$ rad/s. (b) (i) $\frac{k+0.3g}{2k}$, $\frac{k-0.3g}{2k}$, (ii) $0.3g$, (iii) $\pi\sqrt{\frac{0.6}{k}}$.

7) (a) (ii) $\frac{3l}{2}$. (b) (ii) $\frac{W}{2\cos\alpha}\left(16\cos^2\alpha-15\right)$. 8) (b) (i) 14 m/s, (ii) 4.29 s. 9) (a) 0.4 cm.

10) (a) 2.32. (b) (i) $\frac{3}{2}\left(\frac{1}{\sqrt{e}}-\frac{1}{e}\right)$, (ii) $\frac{3}{2}\left(1-\frac{1}{e}\right)$.

1999

1) (a) (i) 744 N (ii) 14880 W (b) 4/t (ii) 75.76 m

2) (a) 50.8 m/s (b) (i) 53.13° S of W (ii) 18 km 3) (a) (i) $\tan^{-1}\frac{1}{2}$ or 45° (b) (i) $4g$

4) (a) (i) g/8 (ii) 0.225g and 0.35g (b) (iii) 10g/17

5) (a) (ii) Both collisions occur at the same spot (b) 4.324 m/s, $\tan^{-1}\frac{29}{39\sqrt{3}}=23.23°$

6) (a) $x=\sqrt{66}\sin(4t+1.4)$ or $x=\sqrt{66}\cos(4t+0.175)$ (b) (i) 0.48 m from p (ii) $a=-250x$

7) (b) $\tan^{-1}6$ 8) (b) (i) 0.83 m (ii) 0.18 (iii) 0.24 m from centre

9) (a) 1.15 (b) 0.01408 kg 10) (a) $v=\tan\left(\frac{\ln x}{7}\right)$ (b) (i) 138.65 m/s (ii) 12.7%

1998

1) (a) $\frac{4}{5}$ (b) (i) $u = 0.1$, $b = 1$, (ii) 94.5 m.

2) (a) (i) 59.4° N of W, (ii) 264.1 s. (b) (i) 39.5° or 18.6° N of E, (ii) 22 s or 44 s.

3) (a) (i) $\tan^{-1} 3$ or 45°. (b) (i) 44.4°, (ii) 45°. 4) (a) (i) 2.57 m/s^2, (ii) 15.9 N. (b) 35.75g.

5) (a) (ii) $e = \dfrac{3m_1 - m_2}{4m_2}$. (b) $\dfrac{7\sqrt{g}}{11}$. 6) (a) (ii) 25. (b) (ii) 0.5 m. 8) (c) (ii) 2.8l.

9) (a) (i) 0.1875g N, (ii) $\frac{1}{7}$. 10) (a) $v = 18/5e$.

1997

1) (a) (i) 6.5, (ii) 21 m. 2) (ii) $0.84\vec{i} + 1.12\vec{j}$ 3) (a) (i) $\sqrt{30g}$, (ii) $\sqrt{300g}$, $\tan^{-1}\frac{1}{3}$. (b) (ii) 15.31 m.

4) (a) (i) $\dfrac{2g}{m+2}$, (ii) $m = 3$. (b) (i) $2T - kmg = kma,\ mg - T = m(2a)$, (iii) $T = \frac{1}{3}mg$.

5) (a) (i) 2u. (b) (i) $\dfrac{\sqrt{3}u}{4}(1-e)\vec{i} + \dfrac{u}{2}\vec{j},\ \dfrac{\sqrt{3}u}{4}(1+e)\vec{i} + 0\vec{j}$, (ii) $e = \dfrac{1}{3}$. 6) (i) $T = \dfrac{mg}{2\sin\beta}$, (iii) $\beta = 30^\circ$

7) (a) (i) $T = \dfrac{13}{10}W$, (ii) $k = \dfrac{125}{6}W$. (b) (i) $T = \dfrac{\sqrt{7}}{2}W$, (ii) 75 cm. 9) (a) 2.36 m^2. (b) (i) 7.5 kg, (ii) 0.5.

10) (a) 0.82. (b) (i) 0.5 m/s, (ii) $8/225$ s.

1996

1) (a) (i) 3.5 m/s^2, (ii) $|oa| = 7$ m. 2) (i) 79.45° S of E, (ii) 44.5 km/hr, (iii) 12 km, (iv) 0.54 hr.

4) (ii) 7 kg: $\dfrac{g}{29}$, 5 kg: $\dfrac{8g}{29}$, 3 kg: $\dfrac{6g}{29}$, (iii) $m = \dfrac{35}{9}$. 6) (a) (i) 0.8, (ii) 0.9 m, (iii) 22.36 m/s^2. 7) (a) $\dfrac{4W}{3}$

8) (b) (i) $\sqrt{\dfrac{16rg + 3p^2}{12r^2}}$, (ii) $\sqrt{\dfrac{16rg}{3}}$. 9) (b) 2 and 3. 10) (a) $y = e^{4\sin x}$

1995

1) (a) (i) 5u. (b) (i) $\sqrt{6g}$, (ii) $\sqrt{\dfrac{2}{3g}}$, (iii) $\dfrac{5}{3}, \dfrac{8}{3}$, 3 m.

2) (a) (i) $64 - 6t$, $62 - 8t$, (ii) 4, 13.6 (b) (i) $p = 0.6$, $q = 0.45$, (ii) 357.14 s.

3) (a) (i) 14.7 m and 9 m, (ii) 7.056 m, (iii) 12.6 m/s. (b) (i) 40.9°, (ii) $\tan\beta < 0$, β is obtuse.

4) (i) $\dfrac{g}{9}$, (ii) $\dfrac{g}{9}$, (iii) $\dfrac{g}{11}$, (iv) $\dfrac{g}{22}$. 5) (a) (i) $v_1 = u(1-3e),\ v_2 = u(1+2e)$, (ii) $e > \frac{1}{3},\ \Rightarrow v_1 < 0$ and $v_2 > 0$

9) (a) 0.5 litres. (b) (i) $\frac{2}{3}$, (ii) 0.098 N, (iii) 128 cm^3. 10) (a) $y = \sqrt{8\tan^{-1} x + 1}$

1994

1) (a) 33.6 m. (b) (i) 9g, (ii) $2f = \dfrac{98}{45}$ m/s^2.

2) (a) (i) $-3\vec{i} + 4\vec{j}$, (ii) 32 m, 24 m. (b) (i) $-(3 + 0.1t)\vec{i} + (4 - qt)\vec{j}$, (ii) 0.2.

3) (a) (i) 10.5, 21, (ii) 30 m. (b) (i) 12.12 m/s, (ii) 12.36 m/s. 4) (ii) $\dfrac{11mg}{13}$, (iii) $\dfrac{44g}{117}$.

6) (i) 3.6 m/s, (ii) 6.68 N, (iii) 1.132 m. 7) (i) W, $\frac{1}{2}W\tan\phi$. 8) (i) $2\pi\sqrt{\dfrac{72r}{19g}}$.

9) (a) (i) 194.175 m^3, (ii) 57,085 N. 10) (a) $y = \dfrac{(1+x)^2}{e^x}$. (b) (ii) 6.44 s.

1993

1) (a) (i) $a = 3$ m/s^2, $u = 1.5$ m/s. (b) (i) 2 s, (ii) 109.6 m.

2) (a) 15.556 m/s, SW. (b) (i) straight across, (ii) 90 s, (iii) 75 m.

3) (b) (i) $\vec{v} = \left(\frac{\sqrt{3}u - gt}{2}\right)\vec{i} + \left(\frac{u - \sqrt{3}gt}{2}\right)\vec{j}$, $\vec{r} = \left(\frac{\sqrt{3}ut}{2} - \frac{gt^2}{4}\right)\vec{i} + \left(\frac{ut}{2} - \frac{\sqrt{3}gt^2}{4}\right)\vec{j}$, (ii) 60°. 5) $\frac{3mu^2}{20}$.

6) (a) (i) $\frac{16\pi}{\sqrt{7}}$, (ii) 0.9354 m/s. (b) (ii) $\frac{l}{24}$. 8) (b) (ii) 2.54 s. 9) (a) 15 cm. (b) (ii) $\frac{2l}{5}$.

10) (a) $y = \sqrt{18} - 1$. (b) (ii) 20 m.

1992

1) (a) 176.4 m. (b) (i) after 3 s and 17 s, (ii) 24.5 m. 2) (i) 9° E of N, (ii) 6.125 hours, (iii) 6 hours.

3) (i) $\tan^{-1}\left(\frac{2}{3}\right)$, $\tan^{-1}\left(\frac{10}{3}\right)$. 5) (ii) $-\frac{\sqrt{3}u}{6}\vec{i} + \frac{u}{2}\vec{j}$, $\frac{\sqrt{3}u}{6}\vec{i} - \frac{u}{2}\vec{j}$, (iii) $\frac{2}{3}$.

6) (a) (ii) 13. (b) (ii) $\frac{\sqrt{7}\pi}{14}$ s, (iii) $\frac{4\sqrt{7}}{7}$ s. 7) (b) (ii) $\frac{W(2\mu\tan\alpha - 1)}{1 - \mu\tan\alpha}$. 8) (b) $2\pi\sqrt{\frac{5r}{3g}}$.

9) (a) 0.03 m. (b) (i) 2066g, (ii)2200g. 10) (a) 2. (b) (i) ln9, (ii) $\frac{70}{\ln 3}$.

1991

1) (a) (i) 3600 m, (ii) 40 s. (b) $\frac{2u - 19.6}{0.5u + 19.6}$. 2) (ii) 0.3$u$, 56.3° S of W. 3) (i) $\frac{2u^2}{g}$, (ii) 1.

4) (i) $\frac{2mg}{3}$ E, $\frac{\sqrt{2}mg}{3}$ E, (ii) $\frac{1}{2}$. 5) (b) (i) $(3-e)\vec{i} + 5\vec{j}$, $(3+e)\vec{i} + 3\vec{j}$, (ii) $\frac{17}{24}$. 6) (a) $\frac{1.2\omega^2}{5g - \omega^2}$. (b) $\frac{2\pi}{7}$.

7) (i) $\frac{1}{2}W\tan\theta$. 8) (b) (i) 1.88 s, (ii) 0.88 m. 9) (ii) $\frac{9}{16}$. 10) (a) $y = \sqrt{2x^2 - 1}$.

1990

1) (b) (ii) $\frac{13t}{4}$ s.. 2) (a) $-28\vec{i} - 8\sqrt{3}\vec{j}$ m/s. (b) (i) 6.25 s, (ii) 6.94 s. 6) (b) 9:11 pm. 7) (b) $\frac{1}{\sqrt{3}}$.

8) (b) (i) $\sqrt{\frac{3\sqrt{2}g}{4a}}$, (ii) $\left(1 + \sqrt{2}\right)$ m. 9) (a) 110 cm^3. (b) (i) 5 cm, (ii) 60g N/m^2. 10) (a) $y = \frac{x}{2 - x}$.

1989

1) (ii) 43.875 m. 2) (i) 23.1 m/s from 60° S of W, (ii) 40.9° S of W. 3) (ii) 15° or 75°, (iii) 58.0°.

4) (i) $\tan^{-1}\frac{1}{3}$, (ii) $\frac{2}{3}$. 6) (ii) 0.6953 s, (iii) 0.3615 m/s. 7) (i) 36.9°, (iii) $4\sqrt{5}g$ N

8) $\frac{r}{\sqrt{2}}$. 9) (a) $\left(1 - \frac{\sqrt{5}}{3}\right)$ m. (b) $T = 0.072\pi g$ N, $R = 0.288\pi g$ N. 10) (a) $y = xe^{x-1}$.

1988

1) (a) 5 m/s. (b) 15g m. 2) (b) $\frac{800\sqrt{3}}{u}$ s. 3) (a) 18.4° or 71.6°.

4) (ii) $\frac{3g}{20}$ m/s^2, $\frac{g}{20}$ m/s^2, $\frac{g}{20}$ m/s^2, $\frac{19g}{10}$ N. 5) (i) $\frac{2}{7}$, (ii) $\frac{u}{14}$, (iii) $\frac{195u^2}{98}$. 6) (i) $3v^2$, (iii) 0.1 m.

7) (iii) $\frac{\sqrt{5}W}{2}$ horizontally. 8) $2\pi\sqrt{\frac{\sqrt{3}l}{g}}$ s. 9) (i) $\frac{l}{2}$. 10) (a) $x = 5\sin\left(2t + \frac{\pi}{2}\right)$. (b) 1.518 s.

1987

1) (a) 30 s. 2) (i) 17.88 km/hr, 8.61° N of W, (ii) 1 hr, 2 hrs & 9 mins. 4) (ii) $\frac{3g}{35}$ m/s^2.

5) (i) $\vec{v}_A = -4\vec{i} + 4\vec{j}$, $\vec{v}_B = -\vec{i} - p\vec{j}$, (iii) 1. 6) (ii) $\frac{2\pi\sqrt{d}}{21}$ s. 7) (iii) 28 N.

8) (i) $2\pi\sqrt{\frac{22p}{3g}}$ s. 9) (a) (i) 0.2 kg, (ii) $\frac{14}{45}$ kg. (b) (ii) 2. 10) (a) $x = \sqrt{3y-5}$. (b) 44.16 s.

1986

1) (a) (ii) 21.25 s. (b) 15 s. 2) (i) 61.44 m, (ii) 69 m. 3) 4.25 s. 4) (ii) $\frac{3g}{11}$.

5) (a) (i) $\frac{3}{5}$. 6) (a) 12 s, 0.849 m. 9) (a) $\frac{d}{\sqrt{2}}$. (b) 0.8. 10) (a) $y = 3xe^{1-x}$.

1985

1) (i) $\frac{25}{u+v}$, (ii) $\frac{3u+v}{4(u+v)}$. 2) (i) $\vec{v} = \left(u\cos\theta - \frac{\sqrt{3}gt}{2}\right)\vec{i} + \left(u\sin\theta - \frac{gt}{2}\right)\vec{j}$,

2) (i) $\vec{r} = \left(u\cos\theta t - \frac{\sqrt{3}gt^2}{4}\right)\vec{i} + \left(u\sin\theta t - \frac{gt^2}{4}\right)\vec{j}$, (ii) $\frac{u^2\sin^2\theta}{g}$, (iii) $\frac{2u\sin 2\theta}{g}$.

3) (ii) $\frac{g(4+x)}{5(2+x)}$, (iii) $\frac{8+22x}{16-x}$. 4) (iii) $\frac{1}{3}$. 5) (a) 7.2 s. (b) (i) $\frac{2600g}{3}$ W, (ii) 29.6 m/s.

6) (i) 0.1π m/s, (ii) 0.128 s, (iii) $\frac{\pi^2}{4}$, (iv) $\frac{g}{\pi^2}$. 8) (ii) $2\pi\sqrt{\frac{3+5x^2}{5gx}}$, (iii) $\sqrt{\frac{3}{5}}$.

9) (a) (i) $\frac{49}{13}$, (ii) 4kg, 6kg, (iii) $\frac{1}{13}$. (b) 1.6 m. 10) (a) $y = \sqrt[3]{x-2}$. (b) (ii) $\frac{u}{\sqrt{3}}$.

1984

1) (a) 0.6 m/s^2, (b) (i) 6 s, (ii) 48 m.. 2) (i) 25.0 m/s at 77.9° N of W, (ii) 2933 m, (iii) 50.4 s.

3) $t = \frac{\sqrt{5}u\sin\theta}{g}$, $R = \frac{\sqrt{5}u^2}{4g}$. 4) (ii) $\frac{g}{11}$, $\frac{2g}{11}$, $\frac{g}{11}$, $\frac{5g}{11}$. 5) (b) 7. 6) (a) $\sqrt{g}$. (b) (ii) $\frac{\sqrt{g}}{2}$.

7) (a) $\frac{15g}{4}$ N. (b) 7 : 5. 9) (a) (i) $\frac{6}{7}$, (ii) 0.9, (iii) 125 ml. (b) $\frac{2\pi\sqrt{d}}{7}$. 10) (a) $v = \frac{1}{k}\left(g - e^{-k(t+c)}\right)$. (b) $\frac{5}{\ln 2}$.

1983

1) 4 s, 3 m/s^2. 2) $\frac{d\sqrt{4x^2-2v^2}}{x^2-v^2}$. 3) (i) $\frac{7g}{32}$ m/s^2, (ii) $\frac{15g}{16}$ N, $\frac{75g}{32}$ N. 4) $\frac{5}{7}$ s, 30 m.

5) (i) $-\frac{1}{3}\vec{i} + 4\vec{j}$ m/s, (ii) $\frac{2}{3}\vec{i} - 3\vec{j}$ m/s; $\frac{24}{23}$. 6) (iii) $2\sqrt{3\sqrt{2}g}$. 7) (i) mg, $\frac{2}{15}$ m, (ii) $5mg$, $\frac{22}{15}$ m.

8) 2.35 m, 0.65 m, 0.404 s 9) (a) 801.6 kg/m^3, 507 mm. (b) (i) $\pi\rho r^3 g$, (ii) $2\pi\rho r^3 g$.

10) (a) $y = 4\sin x$. (b) $\sqrt{500}$ m/s, 400 m.