

Leaving Certificate Applied Maths Higher Level Answers

2016

- 1) (a) (ii) 5 m s^{-1} , (iii) 107.5 m . 2) (a) (i) 11.5 km h^{-1} , (ii) $17.1^\circ \text{ E of N}$, $72.9^\circ \text{ E of N}$. (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} , $19.1^\circ \text{ N of W}$, (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) $\frac{1}{2\sqrt{3}} \text{ m}$, (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) $\sqrt{\frac{7}{10g}} \text{ s}$, 0.22 m .
 5) (a) (ii) $\frac{7}{8}\mu u^2$. (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) 4.06 m .
 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) $W 60^\circ \text{ S}$. 3) (a) (ii) 30° . (b) 31.7° .
 4) (a) (i) $\frac{84g}{13} \text{ N}$, (ii) $\frac{189g}{13} \text{ N}$. (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) $\frac{\pi}{\sqrt{5}} \text{ s}$. (b) (i) $m(l\omega^2 + g)$, $m(l\omega^2 - g)$, (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) $\frac{10}{3} \text{ s}$. (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 $16.3^\circ \text{ E of N}$, (ii) $13:21$, (iii) $1 \text{ hr } 9 \text{ min}$.
 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) $\frac{1}{11} \text{ m}$. (b) (i) $\frac{4mg(1+\mu)}{5}$, (ii) $3f - 2g$.
 6) (a) (i) $\frac{\pi^2}{5} \text{ m s}^{-1}$, (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) $28.955^\circ \leq \theta \leq 60^\circ$.
 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) $\frac{1}{4} < e < 1$. (b) (i) $\frac{1-e}{2}$, (ii) $\frac{3}{4}$. 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) 2.88×10^{-6} m³. (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) $\frac{2}{3}$ 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) $\frac{1}{3}$.
 5) (b) (ii) N, 80.1° W of N, (iii) 13.5%. 6) (a) (ii) 3.03 cm/s. (b) $\frac{900\mu g}{\pi^2 N^2}$. 7) (a) 15 cm. (b) $\frac{W}{2}$.
 8) (b) (i) $6ml^2$, (ii) $\sqrt{\frac{g}{3l}}$. 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/s², $\frac{1}{2}$ m/s², (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) $1-e$, $\frac{1}{2}(1-e^2)$, $\frac{1}{2}(1+e)^2$. 6) (a) (ii) 1.68 m/s, 10.8 m/s². (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) $90-\alpha$,
 6) (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) $\vec{r} = (9.8t)\vec{i} + (29.4t - \frac{1}{2}gt^2)\vec{j}$, $\vec{v} = (9.8)\vec{i} + (29.4t - gt)\vec{j}$, (ii) $\theta = \tan^{-1}(3-t)$, (iii) 4 s, 5 s. (b) $\frac{2u^2}{3g}$.
 4) (a) (i) $\frac{g}{9} \text{ m/s}^2$, (ii) 0.30 s. (b) (iii) 30° . 5) (a) (i) $\frac{7-5e}{2}$, $\frac{7+3e}{2}$, (ii) 15. (b) (i) $\frac{u}{2}(1-e)$, $\frac{u}{2}\sqrt{e^2+2e+5}$
 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) $5.25mg \text{ N}$.
 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) $10\sqrt{2} \text{ m/s}$, (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) $\frac{10g}{3} \text{ N}$, (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) (i) 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 $82.87^\circ \text{ S of E}$, (ii) 25 m, (iii) 4.6 s.
 3) (a) 40 m 4) (a) (i) $\frac{1}{3}g \text{ m/s}^2$, (ii) $\frac{3v^2}{g}$. (b) (ii) $\frac{14g}{11\sqrt{2}} \text{ m/s}^2$, (iii) 0.3 m.
 5) (a) (i) $\frac{u}{8}(3-5e)$, $\frac{3u}{8}(1+e)$, (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) $\frac{1}{2}l$, (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) $\vec{v}_w = 20\vec{i} + 10\vec{j} \text{ km/h}$. (b) (i) 9.01 m/s, $73.9^\circ \text{ S of E}$, (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) $\frac{g}{2} \text{ m/s}^2$. (b) (ii) 1.65 m.
 5) (a) (i) $\frac{u}{16}(3-13e)$, $\frac{3u}{16}(1+e)$, (ii) $0 \leq e < \frac{1}{3}$. (b) (ii) $\frac{1}{2}$. 6) (a) (i) 4 cm, (ii) $2\sqrt{7} \text{ cm/s}$. (b) (ii) 63.6° .
 7) (a) (iii) $\frac{3}{5}$. 8) (b) (i) $2\pi\sqrt{\frac{3l}{g}}$, (ii) $\sqrt{3}l$. 9) (a) (iii) $150\sqrt{10}g \text{ N}$. (b) 12 cm.
 10) (a) $y = (2x^2 - 3)^{\frac{1}{4}}$. (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) $14960\pi^2 \text{ J}$.
 9) (a) $\frac{8}{17}$. (b) $\frac{8}{25}$. 10) (a) $y = \ln(e^x + 3)$. (b) (i) $\ln 3 \text{ s or } 1.1 \text{ s}$, (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) $\frac{7g}{13} \text{ m/s}^2$, $\frac{3g}{13} \text{ m/s}^2$, $\frac{2g}{13} \text{ m/s}^2$, $\frac{2g}{13} \text{ m/s}^2$, (iii) $\frac{2}{3} \text{ m}$. 5) (a) (i) $\frac{u}{5\sqrt{2}} \sqrt{29-12e+9e^2}$, $\frac{\sqrt{2}u}{5}(1+e)$.
- 6) (a) (i) $A = \sqrt{\frac{52}{3}} \text{ cm}$, $T = \frac{2\pi}{\sqrt{3}}$, (ii) $2\sqrt{13} \text{ cm/s}$. (b) (i) $\frac{5l}{4}$, (ii) $\frac{\pi}{3} \sqrt{\frac{l}{g}}$. 7) (b) 4W.
- 8) (b) $\frac{5}{4}mr^2$, $\omega = \sqrt{\frac{8g \sin \theta}{5r}}$, $\omega_{\max} = \sqrt{\frac{8g}{5r}}$. 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) $3\sqrt{2} \text{ m/s}$.
- 6) (a) $2\sqrt{g} \text{ rad/s}$. (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) $\frac{W}{2\cos\alpha}(16\cos^2\alpha - 15)$. 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) $53.13^\circ \text{ S of W}$ (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, $\tan^{-1} \frac{29}{39\sqrt{3}} = 23.23^\circ$
- 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) $59.4^\circ \text{ N of W}$, (ii) 264.1 s. (b) (i) 39.5° or $18.6^\circ \text{ N of E}$, (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) $e = \frac{3m_1 - m_2}{4m_2}$. (b) $\frac{7\sqrt{g}}{11}$. 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) $v = \frac{18}{5e}$.

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) $\frac{2g}{m+2}$, (ii) $m = 3$. (b) (i) $2T - kmg = kma$, $mg - T = m(2a)$, (iii) $T = \frac{1}{3}mg$.
 5) (a) (i) $2u$. (b) (i) $\frac{\sqrt{3}u}{4}(1-e)\vec{i} + \frac{u}{2}\vec{j}$, $\frac{\sqrt{3}u}{4}(1+e)\vec{i} + 0\vec{j}$, (ii) $e = \frac{1}{3}$. 6) (i) $T = \frac{mg}{2\sin\beta}$, (iii) $\beta = 30^\circ$
 7) (a) (i) $T = \frac{13}{10}W$, (ii) $k = \frac{125}{6}W$. (b) (i) $T = \frac{\sqrt{7}}{2}W$, (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) $\frac{8}{225} \text{ s}$.

1996

- 1) (a) (i) 3.5 m/s^2 , (ii) $|oa| = 7 \text{ m}$. 2) (i) $79.45^\circ \text{ S of E}$, (ii) 44.5 km/hr, (iii) 12 km, (iv) 0.54 hr.
 4) (ii) 7 kg: $\frac{g}{29}$, 5 kg: $\frac{8g}{29}$, 3 kg: $\frac{6g}{29}$, (iii) $m = \frac{35}{9}$. 6) (a) (i) 0.8, (ii) 0.9 m, (iii) 22.36 m/s^2 . 7) (a) $\frac{4W}{3}$
 8) (b) (i) $\sqrt{\frac{16rg + 3p^2}{12r^2}}$, (ii) $\sqrt{\frac{16rg}{3}}$. 9) (b) 2 and 3. 10) (a) $y = e^{4\sin x}$

1995

- 1) (a) (i) $5u$. (b) (i) $\sqrt{6g}$, (ii) $\sqrt{\frac{2}{3g}}$, (iii) $\frac{5}{3}$, $\frac{8}{3}$, 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) $\frac{g}{9}$, (ii) $\frac{g}{9}$, (iii) $\frac{g}{11}$, (iv) $\frac{g}{22}$. 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) $2f = \frac{98}{45} \text{ m/s}^2$.
 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) $\frac{11mg}{13}$, (iii) $\frac{44g}{117}$.
 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) $2\pi\sqrt{\frac{72r}{19g}}$.
 9) (a) (i) 194.175 m^3 , (ii) 5825 kg. 10) (a) $y = \frac{(1+x)^2}{e^x}$. (b) (ii) 6.44 s.

1993

- 1) (a) (i) $a = 3 \text{ m/s}^2$, $u = 1.5 \text{ m/s}$. (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) $\ln 9$, (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) $0.3u$, 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) 8:44 pm. 7) (b) $\frac{1}{\sqrt{3}}$.
 8) (b) (i) $\sqrt{\frac{3\sqrt{2}g}{4a}}$, (ii) $(1 + \sqrt{2})$ m. 9) (a) 110 cm^3 . (b) (i) 5 cm, (ii) $60g \text{ N/m}^2$. 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) $4\sqrt{5}g \text{ N}$
 8) $\frac{r}{\sqrt{2}}$. 9) (a) $\left(1 - \frac{\sqrt{5}}{3}\right)$ m. (b) $T = 0.072\pi g \text{ N}$, $R = 0.288\pi g \text{ N}$. 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) $\frac{3g}{20} \text{ m/s}^2$, $\frac{g}{20} \text{ m/s}^2$, $\frac{g}{20} \text{ m/s}^2$, $\frac{19g}{10} \text{ N}$. 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) $\frac{3g}{35} \text{ m/s}^2$.
 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) $\frac{14}{45} \text{ kg}$. (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) $v = \frac{1}{k}(g - e^{-k(t+c)})$. (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) $\frac{7g}{32} \text{ m/s}^2$, (ii) $\frac{15g}{16}$ N, $\frac{75g}{32}$ N. 4) $\frac{5}{7}$ s, 30 m.
 5) (i) $-\frac{1}{3}\vec{i} + 4\vec{j} \text{ m/s}$, (ii) $\frac{2}{3}\vec{i} - 3\vec{j} \text{ m/s}$; $\frac{24}{23}$. 6) (iii) $2\sqrt{3\sqrt{2}g}$. 7) (i) mg , $\frac{2}{15} \text{ m}$, (ii) $5mg$, $\frac{22}{15} \text{ m}$.
 8) 2.35 m, 0.65 m, 0.404 s. 9) (a) 801.6 kg/m^3 , 507 mm. (b) (i) $\pi pr^3 g$, (ii) $2\pi pr^3 g$.
 10) (a) $y = 4 \sin x$. (b) $\sqrt{500} \text{ m/s}$, 400 m.