Exam Papers Answers:

Sample Paper 1:

Q1. (a) (i) $v = 30 \ m/s$ (ii) $20 \ m/s$

Q2. (a) (ii) $32.5 \ mins$ (iii) $\frac{2}{45} \ m/s^2$ (b) (i) 4.907% (ii) $D_n = 1.004 D_{n-1} - A$

(iii) $250A + (120000 - 250A)(1.004)^n$ (iv) €936.50

Q3. (a) (ii) $T = \left(\frac{3k}{k+4}\right) mg$ (iii) $R = \left(\frac{3k}{k+4}\right) mg$ (b) (i) $\frac{x^3}{9}(3 \ln x - 1) + c$ (ii) $160 \ J$

Q4. (a) $15°$ or $75°$ (b) (i) $10.1 \ m$ (ii) $15.4 \ m$

Q5. (a) 2 days Classical, 1 day App Maths (33%) (b) (i) $36.87°$ (ii) $\sqrt{\frac{12}{5} gr}$ or $\frac{14\sqrt{3r}}{5}$ or $4.85\sqrt{r}$

Q6. (a) (i) $\frac{u}{4}, \frac{5u}{4}$ (ii) $0.93 \ m/s$ (b) (i) $v = 2.5(1 - e^{-10t})$ (ii) $0.35 \ m$

Q7. (a) (i) $k = \frac{1}{3}$ (ii) $u = \frac{3}{2} \ m/s$ (b) (i) $v = \frac{u}{(4ntu^n+1)^{\frac{1}{n}}}$ (ii) $v = \frac{u}{\sqrt{1+24u^2}}$

Q8. (a) (i) $v = \frac{12}{7} \ m/s$ (ii) $e = \frac{6}{7}$

Sample Paper 2:

Q1. (a) $25 \ m$ (b) (ii) $39.8 \ m$

Q2. (a) (i) €2700 (ii) €2600; Sell at end of years 1, 2, 3, 4

(b) (i) $v_a = \sqrt{\{\left(\frac{1-e}{2}\right) u \cos \alpha\}^2 + \{u \sin \alpha\}^2}$, $v_b = \left(\frac{1+e}{2}\right) u \cos \alpha$

Q3. (a) $0.228 \ m$ (b) (i) $1.96 \ m/s^2$ (ii) $0.33 \ s$

Q4. (a) (i) $22.5°$ (ii) $165.9 \ m$ (iii) $46.79 \ m/s$

(b) (i) $v = 80 e^{-\frac{1}{100}t}$ (ii) $s = 8000(1 - e^{-\frac{1}{100}t})$ (iii) $v = 80 - \frac{1}{100}s$

Q5. (a) (i) $\frac{u(3-2e)}{5}, \frac{u(3+8e)}{5}$ (b) (i) $P_{n+1} = 0.15 P_n + 3000$

(ii) $\frac{60000}{17} + \frac{365000}{17}(0.15)^n$ (iii) 3602 (iv) 3529

Q6. (a) (ii) $a = (-\omega^2 r \cos \omega t)\vec{i} + (-\omega^2 r \sin \omega t)\vec{j}$ (b) (ii) $f = 0.5$

Q7. (a) $36.87°$

Q8. (a) (i) $49 \ s$ (ii) $31.25 \ s$ (b) (i) $7\sqrt{2} \ m/s$ (ii) $\alpha = 80.41°$

Sample Paper 3:

Q1. (a) (i) $u_n = 600(2)^n - 7(5)^n$ (ii) $n = 5$ (b) (i) $20 \ s$ (ii) $480 \ m$ (iii) $420 \ m$

Q2. (a) (i) $20 \ m/s$ (ii) $1.6 \ m/s^2$ (iii) $10 \ s$ (iv) $\frac{400}{3} \ m$ (b) (i) $SBFGT$ (ii) €21000

Q3. (a) (i) $3.36 \ N$ (ii) $1.4 \ m/s$

Q4. (a) (ii) $49 \ m/s$ (b) (ii) $5 \ m/s$ (iii) $107.5 \ m$

Q5. (a) (i) 0.63 (b) (i) $u_n = -5(2)^n + 6(3)^n$ (ii) 38086

Q6. (a) (i) $\frac{u(8e-1)}{3}, \frac{u(1+4e)}{3}$

Q7. (a) (i) $1 \ s$ (ii) $0.65 \ m$ (iii) $30.87 \ m/s$ (b) (i) $k = 0.07324$ (ii) $28.8 \ days$

Q8. (a) $420 \ m/s$ (b) (i) $7200 \ m$ (ii) $2931.75 \ m$ (iii) $0.54 \ m/s^2$

Sample Paper 4:

Q1. (a) (i) $\frac{u(1-15e)}{4}, \frac{u(1+9e)}{4}$ (b) $x\sin^{-1}2x + \frac{1}{2}\sqrt{1-4x^2} + c$

Q2. (a) (ii) $\sqrt{\frac{8gR}{5}}$ or $3.96\sqrt{R}$ (b) (i) $P_n = 20 + 5(-0.8)^n$ (ii) $P_2 = 23.2\ billion, P_3 = 17.44\ billion$ (iv)

$20\ billion$

Q3. (a) (ii) $ADEHI, 80\ days$ (iii) $B\ (3), C\ (5), D\ (4), G\ (3)$ (iv) $3\ workers$ (b) (i) $8\ s$ (ii) $313.6\ m$

Q4. (a) (ii) $40.66\ m$ (b) $\frac{g}{5}, \frac{g}{5}, \frac{2g}{5}$

Q5. (a) (i) $\begin{pmatrix} 0 & 1 & 1 \\ 0 & 1 & 3 \\ 2 & 0 & 0 \end{pmatrix}$ (ii) $\begin{pmatrix} 6 & 3 & 5 \\ 6 & 7 & 9 \\ 4 & 2 & 6 \end{pmatrix}$ (iii) $5\ walks: (ABBC \times 3, ACAC \times 2)$ (b) (ii) $k = 7$

Q6. (a) $9.84\ m$ (b) (i) $V_n = (500 + 125n)(0.8)^n + 100n - 200$ (ii) False – will continue to increase

Q7. (a) $2.56\ s$ (b) (i) $T = \frac{8mg}{5}$ (ii) $h = 0.0136\ m$ (iii) $R = \frac{6mg}{5}$

Q8. (a) (i) $-22.5°, 67.5°$ (ii) $6.47\ s, 2.68\ s$ (b) (i) $5u, \sqrt{17}\ u$ (ii) $67.17°$

Sample Paper 5:

Q1. (a) (ii) $\frac{210}{17}m$ (b) $6.26\ m/s$

Q2. (a) (i) $87.5\ m, 90\ m$ (b) (ii) $k = 0.0785$ (iii) $3.7\ hrs$

Q3. (a) (i) $a = \frac{g}{3+m}$ (ii) $m = 2$ (b) $u_n = (2)^n + (5)^n + n^2$

Q4. (a) (i) $r = \tan^{-1}t - 0.67$ (ii) $y = -2.7$ (b) (ii) $\frac{u\sqrt{3}(1+7e)}{6(1+e)}$

Q5. (a) (ii) $62.5\ m$ (b) $\frac{1}{13}e^{2x}(2\cos 3x + 3\sin 3x) + c$

Q6. (a) (i) $\frac{u(3-7e)}{2}, \frac{u(3+7e)}{2}$ (b) (ii) $Route: ACEGI, No.\ of\ Bags\ = 64$

Q7. (a) (ii) $2.46\ m$ (iii) $1.88\ m/s$ (b) (i) $v = \sqrt{2gr}$ (ii) $d = \frac{r}{\mu}$ (iii) $5\ m$

Q8. (a) (i) $a = 2, b = -10, c = 15$ (ii) $6\ m/s^2$ (iii) $2.67\ m$ (b) (i) $ADGF, 460\ m$ (ii) $ABEGF, 470\ m$

Sample Paper 6:

Q1. (a) (ii) $\frac{0.134u^2}{g}$ or $0.014u^2$ or $\frac{(2-\sqrt{3})u^2}{2g}$ (b) (i) $x = (P - 40n)e^{\frac{t}{40}} + 40n$ (ii) $4.99\ years$

Q2. (a) (ii) $\frac{3g}{11}\ m/s^2$ (iii) $\frac{40mg}{11}, \frac{16mg}{11}$

Q3. (a) (i) $\frac{u(5-4e)}{3}, \frac{u(5+8e)}{3}$ (ii) $I = \frac{8mu}{3}(1 + e)$ (iii) $k = \frac{16}{3}$ (b) (i) $\begin{pmatrix} 1 & 2 & 0 \\ 2 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$ (ii) $\begin{pmatrix} 9 & 12 & 2 \\ 12 & 4 & 5 \\ 2 & 5 & 0 \end{pmatrix}$ (iii) 12

Q4. (a) (ii) $BD, AC, DF, BC, DE,\ Length = 18\ km$ (iv) $(B, D), (D, F), (B, C), (A, C), (D, E)$

(b) (i) $0°, 71.6°$ (ii) $\sqrt{\frac{2h}{g}}, \sqrt{\frac{20h}{g}}$

Q5. (a) (i) $47.04\ m$ (ii) $33.32\ m/s$ (b) (i) $P_n = 2975(0.5)^n - 1775(0.9)^n + 800n + 2000$ (ii) 9384

Q6. (a) (ii) $T = \frac{8mg}{8+m}$ (iii) $m = 8$ (b) (ii) $d = \frac{3u^2}{2a}$

Q7. (a) (i) $v = 5t + 8e^{-t} - 6$ (ii) $1.35\ m/s$ (iii) $0.73\ m$

(b) (i) $\sqrt{\{\frac{2}{5}u\cos\alpha\}^2 + \{4u\sin\alpha\}^2}, \sqrt{\{\frac{7}{5}u\cos\alpha\}^2 + \{-u\sin\alpha\}^2}$ (ii) $38.66°$

Q8. (a) $k = 2$ (b) $s = \frac{4d}{27}$

SEC HL Sample Paper 2020:

Q1. (a) (ii) $\begin{pmatrix} 0 & 2 & 0 \\ 1 & 1 & 2 \\ 1 & 1 & 0 \end{pmatrix}$ (b) (i) $u_2 = 6, u_3 = 9$ (ii) $u_{n+2} = u_{n+1} + u_n$ (iii) $u_n = 2.171\left(\frac{1+\sqrt{5}}{2}\right)^n +$

$0.829\left(\frac{1-\sqrt{5}}{2}\right)^n$ (iv) 5 older ones

Q2. (ii) Disagree (iii) Agree (v) AEIL (vi) 25 days (vii) 5 days (viii) Morning of July 11th

Q3. (a) $s = ut + \frac{1}{2}at^2 + s_o$ (b) (i) $1.5\,s$ (iii) $16\,m$

Q4. (a) (i) $\frac{1}{e^2}$ (ii) $e^{10}H_0$ (b) (ii) $e = 0.577, \theta = 75°$

Q5. (a) (i) $ACGJLN, 72\,km$ (ii) $140\,km$ (b) (i) $R = \frac{1200.e^{1200kt}}{11+e^{1200kt}}$ (ii) 0.000443

Q6. (i) $\vec{s} = r\cos\omega t\,\vec{\imath} + r\sin\omega t\,\vec{\jmath}$ (ii) $\vec{v} = -\omega r\sin\omega t\,\vec{\imath} + \omega r\cos\omega t\,\vec{\jmath}$ (v) $v_{max} = \sqrt{\mu g r}\,m/s$

Q7. (a) (i) $W = \frac{kx^2}{2}$ (ii) $0.47\,m$ (b) (iii) $T = 1.17\,N, a = 1.9\,m/s^2$

Q8. (a) (i) $P_n = \left(\frac{24000-100B}{3}\right)(1.03)^n + \frac{100}{3}B$ (ii) $P = \frac{e^{0.03n}(240-B)+B}{0.03}$ (iii) Model $1: 12512$, Model $2: 12642$

(v) 240

SEC OL Sample Paper 2020:

Q1. (a) (i) $\vec{b} = 9\vec{\imath} + 12\vec{\jmath}, \vec{c} = 5\sqrt{3}\vec{\imath} - 15\vec{\jmath}$ (ii) -102.06 (iii) $k = 3$

(b) (i) $3.7\,m/s$ (ii) $9.13\,N$ (iii) $T = 28.73\,N$

Q2. (a) (ii) $860\,s$ (iii) B or D (b) (ii) $BFIL$ (iii) $47\,mins$ (iv) $G: 6\,mins$

Q3. (a) (i) $P_n = (92307.69)(1.052)^n + 57692.31$ (ii) €$182,813.92$ (iii) Cormac by €3073.71

(b) (i) $x = 3, -1$ (ii) $u_n = 5(3)^n + 3(-1)^n$ (iii) $1820\,cars$

Q4. (i) $20.38\vec{\imath} + 17.71\vec{\jmath}$ (ii) $24.07\frac{m}{s}, E32.15° N$ (iii) $1.81\,s$ (iv) $16\,m$ (v) $3.323\,s$

Q5. (a) (i) $P = -\frac{1}{4}\vec{\imath}, Q = \frac{11}{4}\vec{\jmath}$ (ii) $\frac{165}{8}m J$ or $20.625m J$

(b) (i) $R_n = 160(0.7)^n$ (ii) $18.82\,cm$ (iii) $489.41\,m$ (iv) $R_{n+1} = R_n$

Q6. (ii) $2g\,N$ (iii) $\frac{18g}{5}\,N$ (iv) $1.77\,m/s$

Q7. (a) $\begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 2 \\ 0 & 1 & 2 & 0 \end{pmatrix}$ (b) $\begin{pmatrix} 4 & 2 \\ -2 & 2 \end{pmatrix}$ (c) $ABGIJ, 148\,passengers$

Q8. (i) $11\,m/s$ (iii) $5t + 0.2t^2$ (iv) $4t + 0.3t^2$ (v) $50\,s$ (vi) $52\,s$

SEC HL Paper 2023:

Q1. (a) (ii) $BCAB$ or $BCDFB$...... (b) (i) $s(t) = 2(1 - e^{-t} - 2e^{-t})$ (ii) 1.6017

Q2. (a) Cheapest $= XAEDJMY$, €11450 (b) $P = \frac{4-8e}{5}\vec{\imath} + \frac{16}{5}\vec{\jmath}, Q = \frac{4+4e}{5}\vec{\imath} + 3.2\vec{\jmath}$

Q3. (iv) 8 complete revolutions (v) $1.5876\,s$

Q4. (iii) $v = \sqrt{\frac{1272e^{-2S}-147}{5}}$ (iv) $1.1\,m$ (vi) $\frac{dv}{ds} = \frac{29.4-v^2}{v}$

Q5. (a) (ii) $1.14\,m/s^2$ (b) $08:23$

Q6. (i) $u_2 = 7, u_3 = 20$ (ii) $u_n = \frac{1}{4}(-1)^n + \frac{3}{4}(3)^n$ (iii) 44287 (iv) $v_n = \frac{1}{8}(3)^n - \frac{1}{8}(-1)^n + \frac{1}{8}n + 1$ (v) 7387

Q7. (a) (i) Min Weight $= 101$ (ii) $137\,mins$ (b) (i) $N = 2000 - 1750e^{-kt}$ (ii) $k = 0.20879$

Q8. (i) $28\,m/s$ (ii) $110.53\,m$ (iii) $\vec{p} = 28.68\vec{\imath} - 4.47\vec{\jmath}, \vec{Q} = -12.32\vec{\imath} + 5.6\vec{\jmath}$ (iv) -378.3696 (v) $15.57°$

Q9. (iii) $AEJL$ or AEK including 2 dummies (v) D, E, F or G

Q10. (a) (i) $U_1 = 180, U_2 = 186$ (ii) $U_{n+1} = 1.2U_n - 30$ (iii) $U_n = 25(1.2)^n + 150$ (iv) 373 (b) (iii) $k = 5$

SEC HL Deferred Paper 2023:

Q1. (a) (i) $\begin{pmatrix} 2 & 7 & -2 \\ -9 & 10 & 8 \\ 7 & 1 & 2 \end{pmatrix}$ (b) (ii) $v = \sqrt{lg\sin\theta\tan\theta}$ (iii) $T = 2\pi\sqrt{\dfrac{l\cos\theta}{g}}$

Q2. (a) (ii) $Dijsktra's, ABDEG, 174\ ms$ (b) (i) $E_n = (101 - \frac{20C}{3})(1.15)^n + \frac{20C}{3}$ (ii) 16 (iii) $\frac{dE}{dn} = 0.15E - C$

Q3. (i) $c = \frac{3}{2}, d = \frac{9}{16}$ (ii) $420\ billion$ (iii) $G_n = 200\left(\frac{3}{4}\right)^n + 40n\left(\frac{3}{4}\right)^n + 640, G_6 = 718\ billion$

Q4. (i) $P = 10e^{0.08t}$ (ii) $52\ weeks$ (iv) $P = \dfrac{20Ke^{0.08t}}{K - 20 + 20e^{0.08t}}$ (v) 95

Q5. (i) $5\ s$ (ii) $v = \frac{1}{k}((g + 20k)e^{-kt} - g)$ (iii) $1.82\ s$ (iv) $\frac{dv}{dt} = g - kv$

Q6. (a) (i) $40.33\ m$ (ii) $376.44\ m$ (b) $Optimal: XBDFY, €60,000$

Q7. (ii) $\frac{u\sqrt{10}}{3}\vec{\imath} + 0\vec{\jmath}$ (iii) $W = \frac{kx^2}{2}$ (iv) $x = \frac{u}{3}\sqrt{\frac{10m}{k}}\ m$

Q8. (ii) $a = 2.19\ m/s^2, T = 47.14\ N$ (iii) $1.32\ m/s$ (iv) $-7.24\ m/s^2$ (v) $0.52\ m$

Q9. (iv) $AEIM$ (v) $16\ hours$ (vi) No

Q10. (ii) $48.19°$ (iii) $3.13\ m/s$ (iv) $0.46\ s$ (v) $2.08\ m$

SEC HL Paper 2024:

Q1. (a) $\begin{pmatrix} -1 & -1 & 2 \\ 13 & 2 & -3 \\ -6 & 11 & 6 \end{pmatrix}$ (b) (i) $586\ km$ (b) (ii) $751\ m$ (c) $6.41s\ or\ 3.59s$

Q2. (a) (ii) $5.37°$ (b) (ii) $\frac{343}{11}N\ or\ 31.18N$

Q3. (a) $\frac{\pi^2 - 4}{8}\ m/s\ or\ 0.73\ m/s$ (b) (i) $\vec{V_a} = -eu\cos\alpha\,\vec{\imath} + u\sin\alpha\,\vec{\jmath}, \vec{V_B} = eu\cos\alpha\,\vec{\imath} + u\sin\alpha\,\vec{\jmath}$

Q4. (ii) $R = \dfrac{mv_1{}^2 - 13.4mg + 20.1mg\cos\alpha}{6.7}$ (iii) $v_2 = \sqrt{v_1{}^2 - 13.4g}$ (vi) $v = \frac{1}{k}\left(g + k(\sqrt{v_1{}^2 - 13.4g})\right)e^{-kt} - \frac{g}{k}$

Q5. (a) (i) $\frac{u - 9eu}{5}, \frac{u + 6eu}{5}$ (ii) $0 < e < \frac{1}{9}$

Q6. (a)(i) $P_{n+1} = 1.0012P_n - x$ (ii) $P_n = \left(13500 - \frac{250x}{3}\right)(1.012)^n + \frac{250x}{3}$ (iii) 148 (iv) 13602

(b) (i) $v = \sqrt{4\ln\left(\frac{2}{2-s}\right)}$ (ii) $0.806\ m/s$

Q7. (a) (i) $\frac{7}{4\cos\alpha}\ s$ (ii) $\alpha = 58.12°\ or\ 35.96°$ (b) (ii) $10.22\ m/s$ (iv) 0.315

Q8. (a)(i) $XCDIY\ giving\ €6000\ profit$

Q9. (i) $M_2 = 395, M_3 = 578.75$ (ii) $M_n = 172.5(\frac{3}{2})^n + 27.5(-\frac{1}{2})^n$ (iii) $3602.8125\ kg$ (iv) $P_n = 175.25(\frac{3}{2})^n + 26.95(-\frac{1}{2})^n - \frac{4}{5}(2)^{n+2}$ (v) $3458\ kg$

Q10. (a) (i) $Finishing\ Time = 21\ days$ (ii) $BEJLM$ (b) $85.175\ s$