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Chapter 8 Problem Solving Set A:

Bronze:

a) i) $h = 1.4 + 0.5(2) - 0.1(2)^2$

$h = 2m$

ii) $h = 1.4 + 0.5(4) - 0.1(4)^2$

$h = 1.8m$

iii) $h = 1.4 + 0.5(6) - 0.1(6)^2$

$h = 0.8m$

b) when $x = 10$

$h = 1.4 + 0.5(10) - 0.1(10)^2$

$h = -3.6m$ ∴ not a valid model as the height is negative, suggesting the ball will be 3.6m into the ground.

Silver:

a) when $x = 0$

$h = 1.2 + 0 - 0.2(0)^2$

$h = 1.2m$

b) $-0.2x^2 + x + 1.2 = h \quad (\times 5)$

$-x^2 + 5x + 6 = h$

$-(x^2 - 5x - 6) = h$

$(x-6)(x+1)$

$x = 6 \quad x = -1$ ↳ can't be negative

↳ $0 \leq x \leq 6$

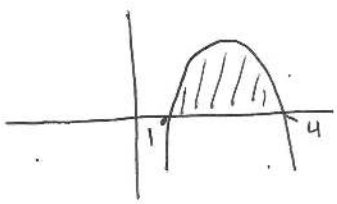
c) $h = 2 \quad x = k$

$1.2 + x - 0.2x^2 > 2$

$1.2 + k - 0.2k^2 > 2$

$-0.8 + k - 0.2k^2 > 0$

$k = 1 \quad k = 4$



∴ $1 < k < 4$

d) $h = 1.2 + x - 0.2x^2$

$\frac{dh}{dx} = 1 - 0.4x$

↳ $1 - 0.4x = 0$

$0.4x = 1$

$x = 2.5$

↳ substitute into original equation

$h = 1.2 + 2.5 - 0.2(2.5)^2$

$= 1.2 + 2.5 - 1.25$

$= 2.45\text{m}$

Gold:

$h = px - 0.02x^2 + q$

$\frac{dh}{dx} = p - 0.04x$

↳ $p - 0.04x = 0$

$x = \frac{p}{0.04}$

$x = 25p$

$x = 60$

↳ $0 = p(60) - 0.02(60)^2 + q$

$0 = 60p - 72 + q$

$h = 25\text{m}$ → height of cliff

↳ $25 = p(0) - 0.02(0)^2 + q$

$\therefore q = 25$ (sub into $60p - 72 + q$)

$0 = 60p - 72 + 25$

$60p = 47$

$p = \frac{47}{60} \approx 0.7833\ldots$

maximum height: $x = 25p$

$x = 25 \times 0.7833 = 19.58$

↳ $(0.7833)(19.58) - 0.02(19.58)^2 + 25$

$= 32.66$

↳ 32.7 m (3sf)

Chapter 8 Problem Solving Set B:

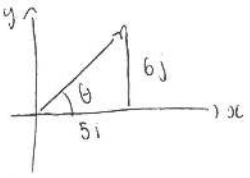
Bronze:

a) $\sqrt{(5)^2 + (6)^2} = \sqrt{61}$

$= 7.810249676$

$= 7.81 \text{ ms}^{-1}$ (3s.f)

b)



$\tan\theta = \frac{6}{5}$

$\theta = \tan^{-1}\left(\frac{6}{5}\right)$

$= 50.2°$ (3sf)

Silver:

a) $\overrightarrow{AB} = \sqrt{(120)^2 + (-200)^2} = 233.24$ (2d.p)

$\overrightarrow{BC} = \sqrt{(150)^2 + (180)^2} = 234.31$ (2d.p)

$\overrightarrow{CD} = \sqrt{(-250)^2 + (80)^2} = 262.49$ (2d.p)

$AD = AB + BC + CD$

$AD = (120i - 200j) + (150i + 180j) + (-250i + 80j)$

$= 20i + 60j$

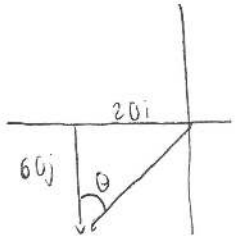
$\overrightarrow{AD} = \sqrt{(20)^2 + (60)^2} = 63.25$ (2d.p)

$233.24 + 234.31 + 262.49 + 63.25 = 793.29$

$793.29 < 800$

∴ the plane has enough fuel to make the deliveries and return to Airport A

b) $\overrightarrow{DA} = -20i - 60j$



$\tan\theta = \frac{20}{60}$

$\tan^{-1}\left(\frac{20}{60}\right) = 18.43$

$180 + 18.43 = 198.43$

$= 198°$

Gold:

$PQ = 900i - 400j$ $\quad PR = 412.3m$

$QR = -500i + aj$

$PQ + QR = 1568m = PR$

$900i - 400j + (-500i + aj) = PR$

$400i + (-400 + a)j = PR$

$\sqrt{(400)^2 + (-400 + a)^2} = 412.3$

$(400)^2 + (-400 + a)^2 = (412.3)^2$

$160000 + (-400 + a)^2 = 170000$

$(-400 + a)^2 = 10000$

$-400 + a = \pm 100$

$a = 400 + 100 = 500$

$a = 400 - 100 = 300$

$|PQ| = \sqrt{(900)^2 + (400)^2} = 985$

Using $a = 300$

$|QR| = \sqrt{(500)^2 + (300)^2} = 583$

$985 + 583 = 1568$

$\therefore \underline{a = 300}$