Exam Solution 2002 Paper 2

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1. From information given we have weigh of spider is

$$19.06 \cdot 10^{-5} \text{kg}$$

Since the humming bird is 18 times the weigh of the spider, the humming bird weighs

$$18 \cdot \left(19.06 \cdot 10^{-5} \text{kg}\right) = 3.431 \times 10^{-3} \text{ kg}$$

2. From information given we have microwave is £150 including vat @ 17.5%.
If we let the cost of the microwave be (m) excluding vat then we can write the following:-

$$m + 0.175 \cdot m = £150$$

Taking out the common factor (m) on the left hand side we get

$$m \cdot (1 + 0.175) = £150$$

Rearranging we get

$$m = \frac{£150}{(1 + 0.175)}$$

$$m = 127.66$$

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3. Solving the equation below we get

$2x^2 + 3x - 7 = 0$ $a = 2$ $b = 3$ $c = -7$
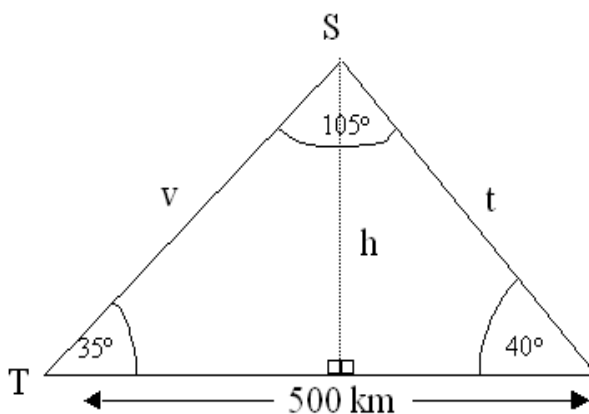
Using the roots formula we have

$$x = \frac{-b + \sqrt{(b^2 - 4ac)}}{2a} \qquad \text{and} \qquad x = \frac{-b - \sqrt{(b^2 - 4ac)}}{2a}$$

$$x = \frac{-3 + \sqrt{\left[3^2 - 4 \times 2 \cdot (-7)\right]}}{2 \times 2} \qquad \text{and} \qquad x = \frac{-3 - \sqrt{\left[3^2 - 4 \times 2 \cdot (-7)\right]}}{2 \times 2}$$

$x = 1.3$ and $x = -2.8$

4. From the information given we can draw the following diagram.

To find the height of the satellite we first find (v) or (t) using the Sine Rule.

Choosing to find (v) we have

$$\frac{s}{\sin(S^o)} = \frac{v}{\sin(V^o)}$$

$$v = \frac{s \cdot \sin(V^o)}{\sin(S^o)} = \frac{500 \cdot \sin(40^o)}{\sin(105^o)} = 332.7 \text{km}$$
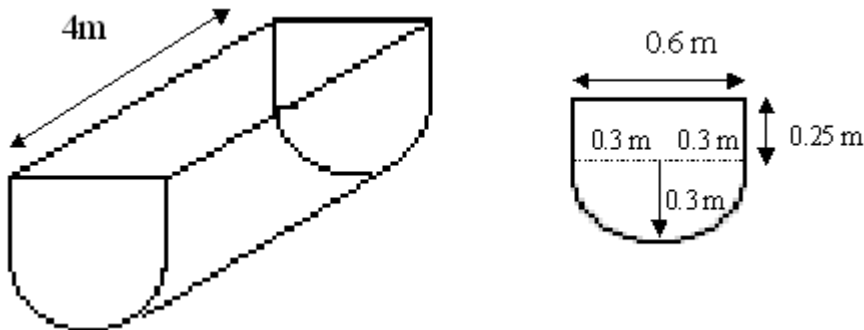
Using Pythagoras Theorem we can now find (h)

$$\sin(35^o) = \frac{h}{v}$$

$$h = \sin(35^o) \cdot v = \sin(35^o) \cdot 332.7 = 190.85 \text{km}$$

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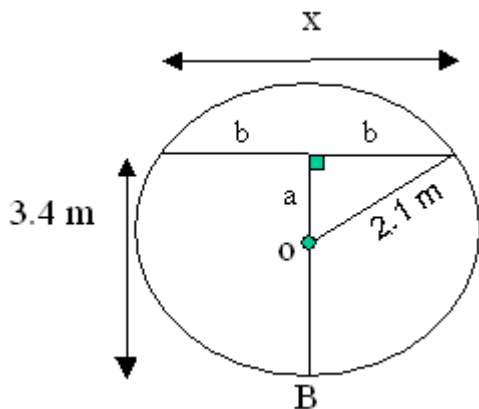**5.**   From the information given we can deduce the following diagram:-

Area of the semi-circle and rectangle is equal to

$$A_{cir\_rec} = \left(\frac{1}{2} \cdot \pi \cdot r^2\right) + (length \cdot breadth) = \left(\frac{1}{2} \cdot \pi \cdot 0.3^2\right) + (0.6 \cdot 0.25) = 0.29 m^2$$

Since trough is uniform then volume is

$$V = A_{cir\_rec} \cdot 4 = 0.29 \cdot 4 = 1.16 = 1.2 m^3 \quad \text{(correct to 2 significant figures)}$$

6.   From the information given we can deduce the following diagram:-

To find x we have
OB is simply the radius of the circle hence it has length 2.1m.
a is the difference between 3.4 and the OB.
$a = 3.4 - 2.1 = 1.3 m$
Using Pythagoras we can find b
$b = \sqrt{(2.1)^2 - a^2} = \sqrt{(2.1)^2 - (1.3)^2} = 1.65 m$
Hence we can now find x.
$x = b + b = 2 \cdot b = 2 \cdot (1.65) = 3.3 m$

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7. From information given we have 1 kg bag contains 0.4 kgs of Brazilian coffee and 0.6 kgs of Colombian.
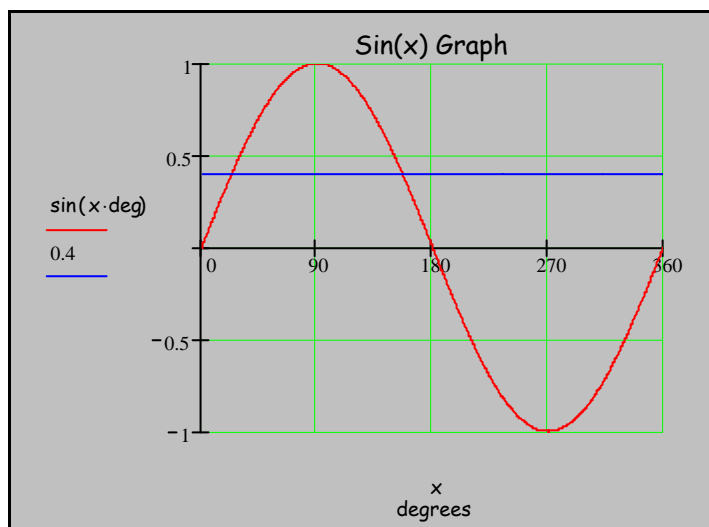
For 20kgs of Brazilian coffee we can fill

$$\frac{20}{0.4} = 50 \quad \text{bags}$$

For 25kgs of Brazilian coffee we can fill

$$\frac{25}{0.6} = 41.7 \quad \text{bags}$$

We must take the lower number. Hence a maximum of 41 bags can be filled with 0.4 kgs of Brazilian coffee and 0.6 kgs of Colombian.

8. From the information given we have

Where the line and sin(x) intersect we have

$$\sin\left(x^{o}\right) = 0.4 \qquad x^{o} = \sin^{-1}(0.4) = 23.6^{o} \qquad \text{and} \qquad 156.4^{o}$$

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9.   From the information given we have

(a)   Easy Call for ten minutes

$$3 \cdot 25 + 5 \cdot 7 = 110$$

(b)   Easy Call formula for m > 3.

$$Cost_{easy} = 75 + 5(m - 3) = 5m + 60$$

(c)   Green Call formula for m > 2

$$Cost_{green} = 80 + 2(m - 2) = 2m + 76$$

(d)   We need to solve

$$2m + 76 < 5m + 60 \qquad -3m < -16 \qquad m > \frac{16}{3}$$

Hence green call is cheaper after 6 minutes

10.   From the information given we have

(a)   T = tension   v = speed   r = radius

$$T \propto v^2 \qquad \text{and} \qquad T \propto 1/r$$

Hence $$T = \frac{k \cdot v^2}{r}$$

(b)   If we multiply the speed by 3 and half the radius the tension will be

$$T = \frac{k \cdot (3 \cdot v)^2}{\frac{r}{2}} = 2 \cdot 9 \cdot \frac{k \cdot v^2}{r} = 18 \cdot \frac{k \cdot v^2}{r}$$

multiplied by 18 times.

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11. From the information given we have

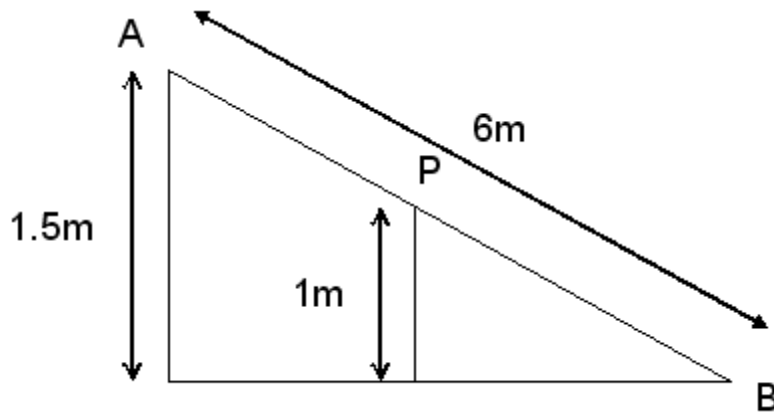(a) $2^n = 32 = 2^1 \cdot 2^1 \cdot 2^1 \cdot 2^1 \cdot 2^1 = 2^5$ $\qquad n = 5$

(b) Following on the sequence get

$(1 + 2 + 4 + 8 + 16) = 32 - 1$

(c) From the information we have the sum of the first n numbers is
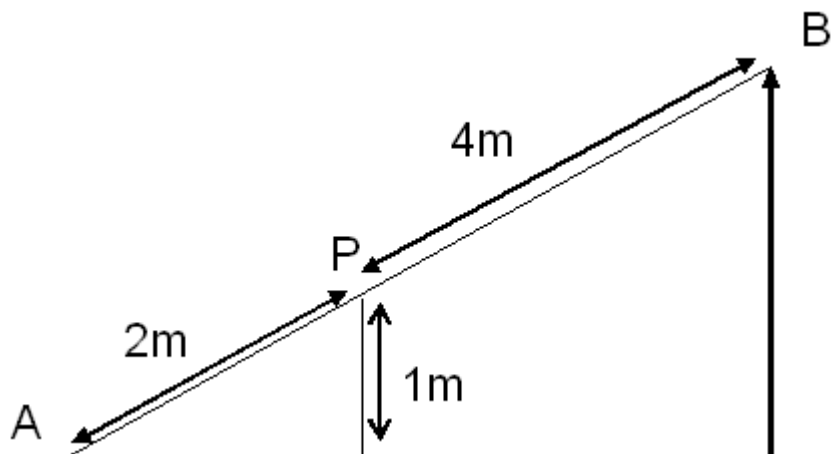
$2^n - 1$

12. From the information given we have

Using Mathematical similarity we have

$$\frac{A}{AB} = \frac{P}{PB} = \frac{1.5}{6} = \frac{1}{PB} \qquad PB = \frac{6}{1.5} = 4 \qquad AP = 2$$

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$$\frac{AP}{P} = \frac{AB}{B} = \frac{2}{1} = \frac{6}{B} \qquad\qquad B = \frac{6}{2} = 3$$