1. $19.06 \times 10^{-5} \times 18 = 0.0034308$

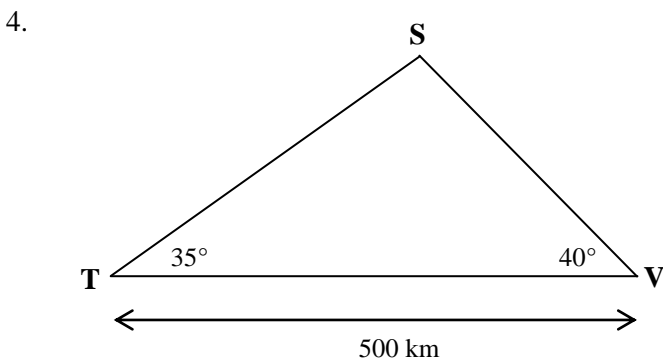 $= 3.43 \times 10^{-3}$ (3 sig figs)

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2. Price includes 17.5% VAT

    So, $117.5\% = £\,150$

    Hence $1\% = \frac{150}{117.5}$

    So $100\% = \frac{150}{117.5} \times 100 = 127.659...$

    Price ex-VAT $= £\,127.66$

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3. $2x^2 + 3x - 7 = 0$

    Use the quadratic formula: a = 2, b = 3, c = -7

    $$x = \frac{-3 \pm \sqrt{3^2 - 4(2)(-7)}}{2(2)} \;\rightarrow\; \frac{-3 \pm \sqrt{9 + 56}}{4}$$

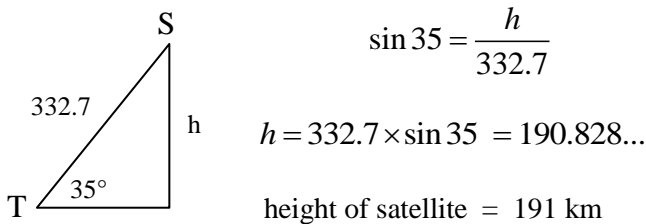 $$x = \frac{-3 \pm \sqrt{65}}{4} \;\rightarrow\; \frac{-3 - 8.06}{4} \; or \; \frac{-3 + 8.06}{4}$$

    $$x = -2.8 \; or \; 1.3 \quad (1\,\text{d.p.})$$

4.


    ASA - use Sine Rule to find either side ST or SV
    The use SOH-CAH-TOA to find perpendicular height.

    First find angle at S = 180° − (35° + 40°)   S is 105°

    $$\frac{ST}{\sin 40} = \frac{500}{\sin 105}$$

    $$ST = \frac{500 \sin 40}{\sin 105} \;\Rightarrow\; ST = 332.731...$$

    $$\sin 35 = \frac{h}{332.7}$$

    $$h = 332.7 \times \sin 35 = 190.828...$$

    height of satellite $= 191$ km


5. Trough is a prism with cross-section as shown.

    Area of cross-section = Area rectangle + semi circle

    Radius of semi-circle = 0.6 m ÷ 2 = 0.3 metres

    Area of cross-section $= 0.6 \times 0.25 + \tfrac{1}{2}\,\pi\,0.3^2$

    $$= 0.15 + 0.1413\ldots = 0.2913\ldots$$

    Volume $= A \times l \quad = \quad 0.2913\ldots \times 4$

    Volume of trough $= 1.1654866\ldots = 1.2$ m^3 (2 s.f.)

6.
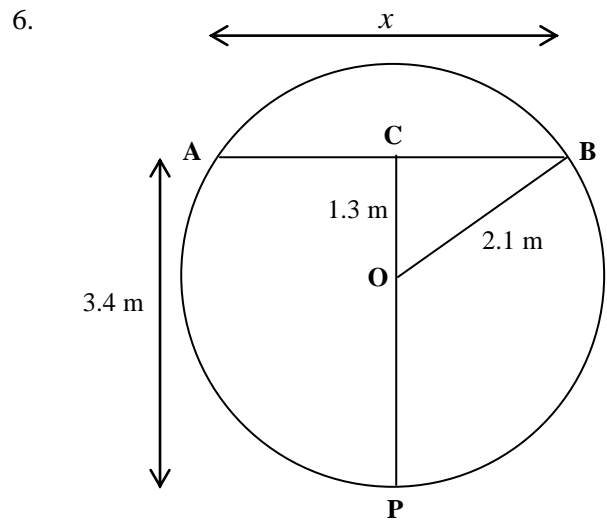
    a)   OP = 2.1 m (radius)

        Hence,   OC = 3.4 – 2.1 = 1.3 m

        Using Pythagoras in Δ OCB

        $$CB^2 + 1.3^2 = 2.1^2$$

        $$CB^2 = 2.1^2 - 1.3^2$$

        $$CB = \sqrt{2.72} = 1.649...$$

        But x is twice CB

    So, width of oil = 3.298... = 3.30 m (3 s.f.)

    b) By symmetry, the other depth of oil is

        2.1 − 1.3 = 0.8 m
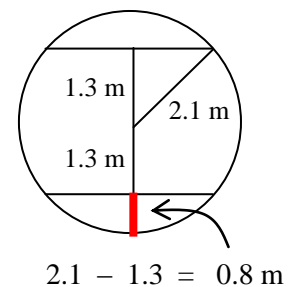
7.   Brazilian : Columbian

                        2   :   3

20 kg of Brazilian, would require 30 kg of Columbian coffee,
there is not enough Columbian coffee, so we need
to see how much an be made with the Columbian coffee

Each 1 kg tin contains

400 gm Brazilian : 600 gm Columbian

So 25 kg = 25 000 gm

$25\ 000 \div 600 = 41.667$ ..... tins

Hence 41 one kg tins can be made

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8. We have to solve the simultaneous equations
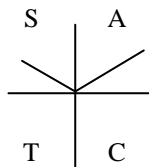
$$y = 0.4 \quad and \quad y = \sin x$$

Hence, solve $\sin x = 0.4$

acute value of x is $\sin^{-1} 0.4 = 23.6°$

Use ASTC

sine is positive (+)

So quadrants 1 & 2

S	A
T	C

Hence, x is $23.6°$ or $180 - 23.6° = 156.4°$

Co-ords are: A ($23.6°$, 0.4) and B($156.4°$, 0.4)

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9. a) Cost of 10 minutes Easy Call
     $= 3 \times 25p + 7 \times 5p = £1.10$

   b) **Easy Call:** Cost of m minutes ($m > 3$)

     $= 75 + (m-3) \times 5$ pence
     $= 75 + 5m - 15$
     $= 60 + 5m$ pence.

   c) **Green Call:** Cost of m minutes ($m > 2$)

     $= 80 + (m-2) \times 2$ pence
     $= 80 + 2m - 4$
     $= 76 + 2m$ pence

   d) **For Green Call to be cheaper, then**

          $76 + 2m < 60 + 5m$
          $76 - 60 < 5m - 2m$
             $16 < 3m$
               $m > 16 \div 3$
               $m > 5.33$ minutes

     Least number of minutes used for this to be true
     is **6 minutes** (to nearest minute)

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10. a) $T = \dfrac{kv^2}{r}$

   b) Speed $\times 3$ then $T \times 3^2$

     Radius is halved then $T \times 2$

     If both occur then $T \times 3^2 \times 2 = T \times 18$

     Hence, Tension, T, is multiplied by 18

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11. a) $2^n = 32 \implies n = 5$

   b)   Expression for 5 numbers is:

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

   c)   From above we see

     Last number of 5 numbers is 16, i.e. 2^4

     5 numbers $\rightarrow 2^{5-1} = 2^4$
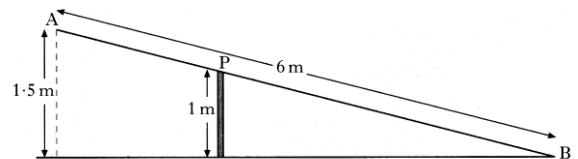
     Last number of n numbers is 2^{n-1}

     $(1 + 2 + \dots\dots + 2^{n-1}) = 2 \times 2^{n-1} - 1$
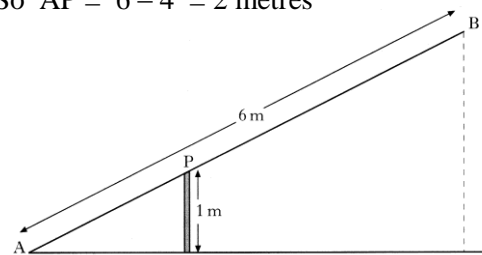
     i.e. $2^n - 1$

12.

Figure 1

Use similar triangles

$$\frac{BP}{BA} = \frac{1}{1.5} \quad \rightarrow \quad \frac{BP}{6} = \frac{1}{1.5}$$

Hence $BP = \dfrac{6}{1.5} = 4$ metres

So $AP = 6 - 4 = 2$ metres

Using similar triangles again

$$\frac{ht\ B}{ht\ P} = \frac{AB}{AP} \quad \rightarrow \quad \frac{ht\ B}{1} = \frac{6}{2}$$

So height of B above the ground = 3 metres.

END OF QUESTION PAPER   (*Rev. March 2007*)