# Intermediate 2 Units 1, 2, 3 Paper 2 2006

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Graduate Bsc (Hons) MathsSci (Open) GIMA

1. Given the value of a boat decreases from £35000 to £32 200 in 1 year.

(a) Percentage decrease is: $\frac{35000-32200}{35000}\times 100 = 8\%$

(b) The value of the boat decrease at this rate for 3 years.

New value is: $32200\times(0.92)^3 = £25100$ to nearest £

2. Solving the simultaneous equations we get:

$4x+2y=13$ eqn 1
$5x+3y=17$ eqn 2

multiply eqn 1 by 3 and eqn 2 by 2
$12x+6y=39$ eqn 3
$10x+6y=34$ eqn 4

subtract eqn4 from eqn 3

$2x=5 \qquad x=2.5$

sub in eqn 1 to find $y$

$4\times 2.5+2y=13 \qquad 2y=3 \qquad y=1.5$

Remember you can check values by substituting them into any of the other equations.

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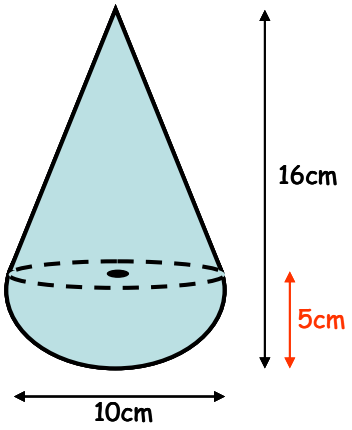
Q3. Given the diagram and that the toy is made up of a cone and hemisphere.




Calculating the volume we get:

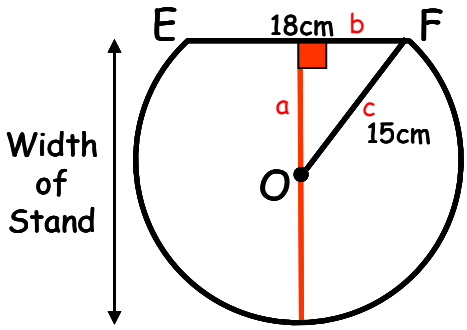
Red value added to diagram.

$$V = \frac{1}{3}\pi r^2 h + \frac{1}{2}\left(\frac{4}{3}\pi r^3\right)$$

$$= \frac{1}{3}\times\pi\times 5^2\times 11 + \frac{1}{2}\times\left(\frac{4}{3}\times\pi\times 5^3\right)$$

$$= 550cm^3 \quad \text{to 2 sig. figs}$$

Q4. Given the diagram and the centre of the circle is O.
EF is a chord of the circle.
EF is 18 cm.
The radius OF is 15cm.




Knowing the properties of a circle
Red values have been added to diagram.

The width of the stand is:

Radius + height of right angled triangle
15 + 12 = 27cm

By Pythagoras

$$a^2 + b^2 = c^2$$

$$a^2 = c^2 - b^2$$

$$a^2 = 15^2 - 9^2$$

$$a = \sqrt{15^2 - 9^2} = 12$$

Q.5 Given the temperatures for the central heating system.

19 21 23 21 19 20

(i) The mean is: $\frac{(19+21+23+21+19+20)}{6} = 20.5^{o}C$

(ii) The standard deviation is:

| x | $x^2$ |
|---|---|
| 19 | 361 |
| 21 | 441 |
| 23 | 529 |
| 21 | 441 |
| 19 | 361 |
| 20 | 400 |
| $\Sigma x =$ 123 | $\Sigma x^2 =$ 2533 |

$(\Sigma x)^2 =$ 15129

$$s = \sqrt{\frac{\sum x^2 - \left(\sum x\right)^2 / n}{n-1}}$$

$$s = \sqrt{\frac{2533 - 15129/6}{6-1}}$$

$$s = \sqrt{\frac{2.3}{5}}$$

$$s = 1.52^{o}C$$

5. (b) Given the central heating is working correctly if it is within 0.6°C of the target temperature of 20°C and the standard deviation is less than 2°C.

The system working correctly since the mean is 20.5°C which is within 0.6°C of the target and the standard deviation is 1.52°C which is less than 2°C.

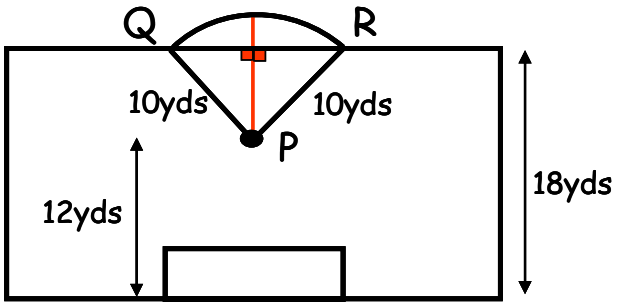
6. Factorising $4p^2 - 49$

Difference of 2 squares $(2p-7)(2p+7)$

7. Expressing $\frac{3}{(x+1)} - \frac{1}{(x-2)}$ as a single fraction in its simplest form:

$$\frac{3}{(x+1)} - \frac{1}{(x-2)} = \frac{3(x-2)-(x+1)}{(x+1)(x-2)} = \frac{3x-6-x-1}{(x+1)(x-2)} = \frac{2x-7}{(x+1)(x-2)}$$

8. Given the diagram of the penalty area on a football pitch.
QR is an arc of a circle centre P.




(a) Angle QPR is:

Red values added to diagram

$$S^{O}HC^{A}HT^{O}A$$

$$\cos\theta = \frac{6}{10}$$

$$\theta = \cos^{-1}\left(\frac{6}{10}\right) = 53.13^{o}$$

$$QPR = 2 \times 53.1 = 106.3^{o}$$

(b) Length of arc QR is:

$$length_{arcQR} = \frac{arc^{o}}{full\ circle^{o}} \times 2\pi r$$

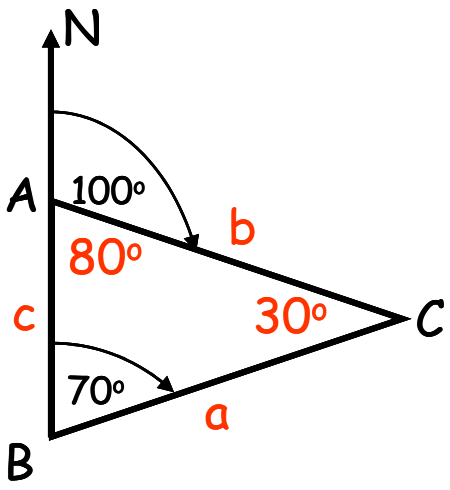
$$length_{arcQR} = \frac{106.3^{o}}{360^{o}} \times 2 \times \pi \times 10$$

$$length_{arcQR} = 18.8 yards$$

9. Changing the subject of the formula to $x$ we get:

$$\frac{x}{c} + a = b$$
$$x + ac = bc$$
$$x = bc - ac$$
$$x = c(b - a)$$

Q10. Given the diagram and that Alan sets off from A with an average speed of 5.6km/h.




Bob sets off from B at the same time and both meet after 3 hours.

To find Bob's average speed we have:

Red values have been added to diagram.

Alan travelled: D = ST
D = 5.6 x 3 = 16.8 km

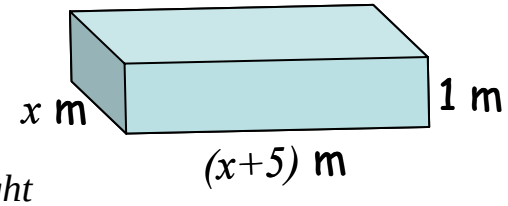
$$\frac{a}{\sin A^o} = \frac{b}{\sin B^o} = \frac{b}{\sin C^o}$$

$$\frac{a}{\sin 80^o} = \frac{16.8}{\sin 70^o}$$

$$a = \frac{16.8 \times \sin 80^o}{\sin 70^o} = 17.6km$$

Bob has an average speed of 17.6 ÷ 3 = 5.9 km/hr. Bob is faster by 0.3km/hr.

Q11. Given the diagram and the volume is $24cm^3$.




(a) We have:

$$V = length \times breadth \times height$$
$$24 = (x+5)\times(x)\times 1$$
$$24 = x^2 + 5x$$
$$x^2 + 5x - 24 = 0 \quad \text{as required}$$

(b) To find breadth solve for $x$.

$$x^2 + 5x - 24 = 0$$
$$(x+8)(x-3) = 0$$
$$x = -8 \qquad x = 3$$

We reject $x$ = -8 as a length cannot be negative, $x$ = 3.

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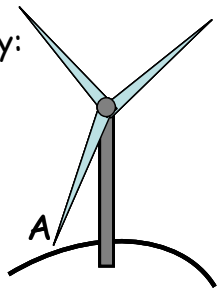
Q12. Given diagram and height $h$ above point A at time $t$ is given by:




$$h = 8 + 4\sin t^o$$

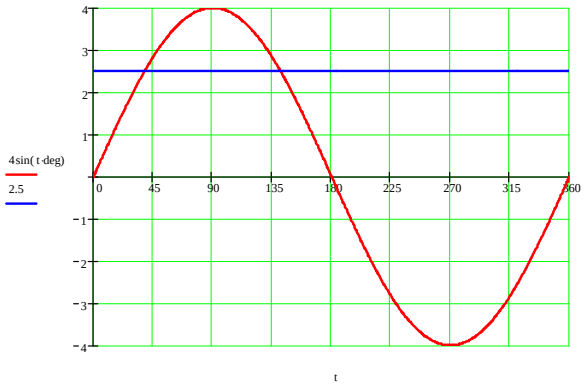
(a) At t = 30s $h = 8 + 4\sin 30^o = 10m$

(b) The two times where point A is 10.5 metres above the ground is:

$$10.5 = 8 + 4\sin t^o$$
$$8 + 4\sin t^o = 10.5$$
$$4\sin t^o = 10.5 - 8$$
$$4\sin t^o = 2.5$$
$$\sin t^o = \frac{2.5}{4}$$
$$t^o = \sin^{-1}\left(\frac{2.5}{4}\right) = 38.7\text{s}$$

$0 \le t^o \le 360^o$

Graphically




The two values are 38.7s and 180s – 38.7s = 141.3s