

Paper 2 Revision Questions – Solutions

1. Calculations with the Calculator

- a) $19.06 \times 10^{-5} \times 18$ Calc: $19.06 \text{ EXP } -5 \times 18$
 $= 3.4308 \times 10^{-3}$ or 0.0034308 kg
- b) $5.6 \times 10^{-11} \times 100,000,000$
 $= 5.6 \times 10^{-3} \text{ mm}$ (now divide by 1000 for metres)
 $= 5.6 \times 10^{-3} \div 1000 = 5.6 \times 10^{-6} \text{ metres}$
- c) $4.5 \times 9.46 \times 10^{12} = 4.257 \times 10^{13} \text{ km}$
- d) mass of water as percentage of mass of earth
 $\frac{\text{mass water}}{\text{mass earth}} \times 100 = \frac{1.41 \times 10^{18}}{5.97 \times 10^{21}} \times 100$
 $(1.41 \text{ EXP } 18 \div 5.97 \text{ EXP } 21) \times 100$
 $= 0.0236 \%$

2. Percentages, Appreciation, Depreciation.

- a) Increase by 17.5% means $\times 1.175$
You pay $149.99 \times 1.175 = \text{£}176.24$
or find the VAT and add it on.
 $\text{£}149.99 \times 0.175 = \text{£}26.25$
now add it on: $\text{£}149.99 + \text{£}26.25 = \text{£}176.25$
Note the difference of 1p. This is due to a rounding error on the calculator as a result of how it stores numbers. It is difficult to avoid. Either answer would be marked as correct.
- b) This time we need to work BACK to the original price.
Let original price = $\text{£}p$
Then: $p \times 1.175 = 2878.75$
So: $p = \frac{2878.75}{1.175} = \text{£}2450$
Check by adding back the VAT.
- c) Appreciation of 3%, multiply by 1.03 (4 times)
 $35000 \times 1.03 \times 1.03 \times 1.03 \times 1.03 = \text{£}39,392.81$
or use the y^x key
 $3500 \times 1.03 y^x 4 = \text{£}39,392.81$
- d) This time the depreciation is different each year.
 $17,500 \times 0.75 \times 0.8 \times 0.85 = \text{£}8,925$
Remember if it loses 25% of its value it will only be worth 75% of the original value, and so on.

- e) Jan 1999 to Jan 2002 is 3 years.
12% decrease means 88% left after each year.

$$5000 \times 0.88^3 = 3407 \text{ monkeys left.}$$

f)

Starting Amount owed	£ 500.00
1 st payment 15 th May	£ 100.00
Balance	£ 400.00
Add interest end of May 2.5%	£ 10.00
Balance due start June	£ 410.00
Payment 15 th June	£ 100.00
Balance	£ 310.00
Add interest end of June 2.5%	£ 7.75
Balance due start July	£ 317.75
Payment 15 th July	£ 100.00
Balance	£ 217.75
Add interest end of July 2.5%	£ 5.44
Balance due start August	£ 223.19

Amount outstanding
at beginning of August = $\text{£}223.19$

- g) 1999 to 2002 is 3 years.
Appreciation of House:
 $90\,000 \times 1.05^3 = \text{£}104,186.25$
Depreciation of contents
 $60\,000 \times 0.92^3 = \text{£}46,721.28$
Total value of House and contents:
 $\text{£}104,186.25 + \text{£}46,721.28 = \text{£}150,907.53$

3. Algebra, Graphs & Trigonometry

- a) Use the formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
 $2x^2 + 3x - 7 = 0$ so $a = 2$, $b = 3$, $c = -7$
$$x = \frac{-(3) \pm \sqrt{(3)^2 - 4(2)(-7)}}{2(2)}$$
$$x = \frac{-3 \pm \sqrt{9 + 56}}{4} = \frac{-3 \pm \sqrt{65}}{4}$$
$$x = \frac{-3 + \sqrt{65}}{4} \text{ or } \frac{-3 - \sqrt{65}}{4} \quad x = 1.26.. \text{ or } -2.765..$$

Hence: $x = 1.3$ or -2.8 (1 dec. place)

Paper 2 Revision Questions – Solutions (cont.)

3b) Use the formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$$x^2 + 3x - 5 = 0 \quad \text{so } a = 1, b = 3, c = -5$$

$$x = \frac{-(3) \pm \sqrt{(3)^2 - 4(1)(-5)}}{2(1)}$$

$$x = \frac{-3 \pm \sqrt{9 + 20}}{2} = \frac{-3 \pm \sqrt{29}}{2}$$

$$x = \frac{-3 + \sqrt{29}}{2} \text{ or } \frac{-3 - \sqrt{29}}{2} \quad x = 1.19.. \text{ or } -4.19..$$

Hence: $x = 1.2$ or -4.2 (2 sig figs)

c) $5(x - 4) + 3 \leq 9$

remove brackets: $5x - 20 + 3 \leq 9$

simplify: $5x - 17 \leq 9$

rearrange: $5x \leq 9 + 17$

simplify: $5x \leq 26$

divide by 5: $x \leq \frac{26}{5} \rightarrow x \leq 5\frac{1}{5}$

d) $2 - 7(2x - 3) \leq 11$

remove brackets: $2 - 14x + 21 \leq 11$

simplify: $23 - 14x \leq 11$

rearrange to get positive x $23 - 11 \leq 14x$

simplify: $12 \leq 14x$

divide by 14: $\frac{12}{14} \leq x$

read from opposite direction: $x \geq \frac{12}{14}$

cancel: $x \geq \frac{6}{7}$

e) Let burger cost b pence
and fries cost f pence.

$$3b + 2f = 1345 \quad \dots(1)$$

$$4b + 5f = 2050 \quad \dots(2)$$

Solve equations simultaneously

$$(1) \times 4 \quad 12b + 8f = 5380 \quad \dots(3)$$

$$(2) \times 3 \quad 12b + 15f = 6150 \quad \dots(4)$$

subtract: (4) - (3)

$$7f = 770 \quad \rightarrow \quad f = 110$$

substitute in (1)

$$3b + 2(110) = 1345$$

$$3b + 220 = 1345$$

$$3b = 1125 \quad \rightarrow \quad b = 375$$

Hence burger costs £3.75 and fries cost £1.10

f) i) Let cost of night stay = £ n and
cost of breakfast = £ b .

$$3n + 2b = 145 \quad \dots(1)$$

$$\text{ii) } 5n + 3b = 240 \quad \dots(2)$$

iii) multiply (1) $\times 3$

multiply (2) $\times 2$

$$9n + 6b = 435 \quad \dots(3)$$

$$10n + 6b = 480 \quad \dots(4)$$

$$(4) - (3) \rightarrow n = 45$$

substitute in (1)

$$3(45) + 2b = 145$$

$$135 + 2b = 145$$

$$2b = 10 \quad \rightarrow \quad b = 5$$

Cost of one breakfast = £5.

Note: since you only have to find the cost of 1 breakfast -
i.e. the value of b , you could simply eliminate n in the pair
of equations which would save a bit of work.

i.e. multiply (1) $\times 5$

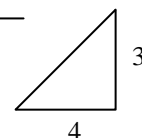
multiply (2) $\times 3$

$$15n + 10b = 725 \quad \dots(3)$$

$$15n + 9b = 720 \quad \dots(4)$$

$$\text{and } (3) - (4) \text{ gives } \rightarrow b = 5$$

g) Draw a triangle
Find the gradient: 'Rise over run'



$$\text{Gradient is: } m = \frac{3}{4} \quad \text{y-intercept: } c = 3$$

$$\text{Equation is: } y = mx + c \quad \rightarrow \quad y = \frac{3}{4}x + 3$$

$$\text{At point L, } y = 0, \text{ so } \rightarrow 0 = \frac{3}{4}x + 3$$

Solve for x :

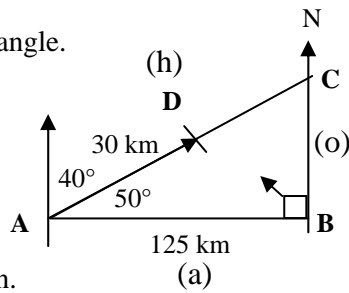
$$\rightarrow -3 = \frac{3}{4}x \rightarrow -12 = 3x \rightarrow x = -4 \quad \mathbf{L(-4, 0)}$$

Paper 2 Revision Questions – Solutions (cont.)

h) Form a right angled triangle.

Bearing is 040°

Angle inside triangle is 50°



Label triangle as shown.

We first need to find length AC

Using SOH-CAH-TOA in triangle ABC

✓ ✓ ✓
SOH-CAH-TOA

(We have adjacent, we want hypotenuse)

Use cosine.

$$\text{So, } \cos 50 = \frac{125}{AC} \rightarrow AC \cos 50 = 125$$

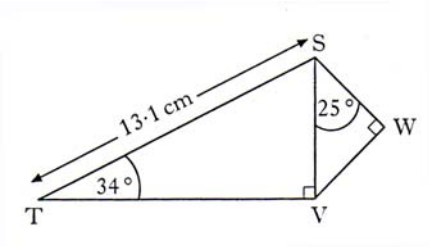
$$\text{Hence, } AC = \frac{125}{\cos 50} \rightarrow AC = 194.465\dots$$

Since plane has travelled 30km already,

There is $194.465\dots - 30$ km to go.

i.e. Distance to travel: 164.5 km (1 dp)

i)



To calculate SW we need a side in $\triangle SWV$

We should find SV. We can find SV in $\triangle STV$

Using SOH-CAH-TOA in triangle STV:

(we have hypotenuse, we want opposite)

$$\sin 34 = \frac{SV}{13.1} \rightarrow 13.1 \sin 34 = SV$$

Hence $SV = 7.33$ cm

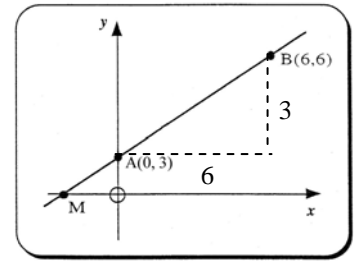
Using SOH-CAH-TOA in triangle SVW:

(we now have hypotenuse, we want adjacent)

$$\cos 25 = \frac{SW}{7.33} \rightarrow 7.33 \cos 25 = SW$$

Hence $SW = 6.643\dots = 6.6$ cm

j)



i) Equation of straight line: $y = mx + c$

m = gradient (rise over run) and c = y-intercept

Using coordinates, draw the triangle and work out length of sides.

(vertical = 3 and horizontal = 6)

$$m = \frac{\text{rise}}{\text{run}} = \frac{3}{6} = \frac{1}{2} \quad c = 3 \text{ (y-intercept)}$$

$$\text{Hence: } y = \frac{1}{2}x + 3 \rightarrow 2y = x + 6$$

(multiplying throughout by 2)

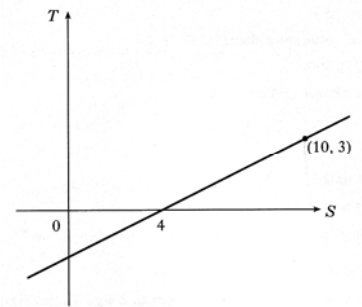
ii) To find M, we know that y-coordinate = 0

So put $y = 0$ in the above equation.

$$0 = x + 6 \rightarrow x = -6$$

Coordinates of M are $(-6, 0)$

k) Similar to last question.



$$m = \frac{\text{rise}}{\text{run}} = \frac{3}{6} = \frac{1}{2}$$

But this time we do not know the y-intercept.

So first put the equation together.

$$y = mx + c \rightarrow y = \frac{1}{2}x + c$$

However, we know that the point $(4, 0)$ lies on the line, so this must satisfy the equation.

Put this value into the equation:

$$y = \frac{1}{2}x + c \rightarrow 0 = \frac{1}{2}(4) + c \rightarrow 0 = 2 + c \rightarrow c = -2$$

$$\text{Hence equation is: } y = \frac{1}{2}x - 2$$

Multiply throughout by 2:

$$\rightarrow 2y = x - 4$$

Paper 2 Revision Questions – Solutions (cont.)

4b) Method 1. Using the standard formula:

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

x	$x - \bar{x}$	$(x - \bar{x})^2$
49	3	9
44	-2	4
41	-5	25
52	6	36
47	1	1
43	-3	9
276		84

↑
 $\sum x$

↑
 $\sum(x-\bar{x})^2$

$$\text{Mean : } \bar{x} = \frac{\sum x}{n} = \frac{276}{6} = 46$$

Mean price of a litre of milk is: 46p

Now use the formula:

$$s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}} \quad \text{where}$$

$$\sum(x-\bar{x})^2 = 84 \quad \text{and} \quad n = 6$$

$$\text{We get } s = \sqrt{\frac{84}{5}} = \sqrt{16.8} = 4.0987\dots$$

standard deviation is 4.1p (to 1 d.p.)

Since the standard deviation of the price of a kilogram of sugar is lower, this indicates that the price is less variable. i.e. there is more variation in the price of milk than there is of sugar.

Method 2 (data only if you want to try this)

x	x^2
49	2401
44	1936
41	1681
52	2704
47	2209
43	1849
276	12780

$$s = \sqrt{\frac{12780 - \frac{(276)^2}{6}}{6-1}} = \sqrt{\frac{84}{5}} \quad \text{then as above.}$$

5. Problem Solving

a) i) Volume of mug

$$V = \pi r^2 h = \pi \times 5^2 \times 14 = 1099.557\dots$$

$$\text{Volume of mug} = 1100 \text{ cm}^3$$

ii) Now find the height of 600ml of coffee.

Using the above formula:

$$\text{Note: } 1 \text{ ml} = 1 \text{ cm}^3$$

$$V = \pi r^2 h \rightarrow 600 = \pi \times 5^2 \times h$$

Rearrange formula to make h the subject.

$$\rightarrow h = \frac{600}{\pi \times 5^2} \rightarrow h = \frac{600}{78.5398}$$

$$h = 7.639\dots$$

Depth of coffee = 7.6 cm.

b) Find volume of cylindrical container:

$$V = \pi r^2 h = \pi \times 12.5^2 \times 35 = 17180.58 \text{ cm}^3$$

If depth of fuel in cuboidal container is d cm

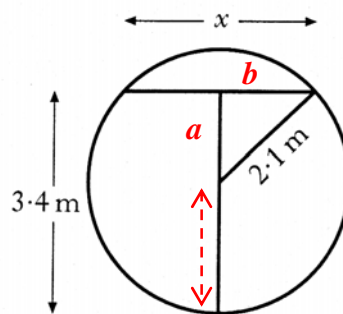
$$17180.58 = 45 \times 30 \times d$$

Rearranging:

$$d = \frac{17180.58}{45 \times 30} = 12.726\dots \text{ cm}$$

So depth of fuel in cuboidal tank = 12.7 cm

c) This problem uses Pythagoras



Dotted line is also 2.1 m (a radius)

So a is $3.4 - 2.1 = 1.3$ metres.

Now find b in this right angled triangle.

$$\text{By Pythagoras: } 2.1^2 = 1.3^2 + b^2$$

$$\text{Rearranging: } b^2 = 2.1^2 - 1.3^2 = 2.72$$

So, $b = 1.649\dots$ and x is twice this, $x = 3.298\dots$

Width of surface of water $x = 3.3$ m

By symmetry, the other depth of water is when the diagram is rotated through 180° .

So the depth is $4.2 \text{ m (dia.)} - 3.4 = \mathbf{0.8 \text{ metres.}}$

Paper 2 Revision Questions – Solutions (cont.)

5 d) i) Volume of can

$$V = \pi r^2 h$$

$$= \pi \times 3.25^2 \times 15 = 497.746... \text{cm}^3$$

Volume of can = 497.7 cm^3

ii) Now find new diameter.

Using the above formula:

$$V = \pi r^2 h \rightarrow 497.7 = \pi \times r^2 \times 12$$

Rearrange formula to make r the subject.

$$\rightarrow r^2 = \frac{497.7}{\pi \times 12}$$

$$\rightarrow r^2 = \frac{497.7}{37.699} = 13.201...$$

$$r = 3.63344.. \quad d = 7.2668....$$

New Diameter = 7.3 cm

e) Let $OB = r$

Then OD also = r

Since $CD = 2$,
Then $OC = r - 2$

Since $AC = 6$,
Then $CB = 3$

Now put this information onto a diagram of a right angles triangle.

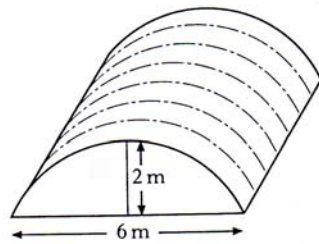


Figure 1

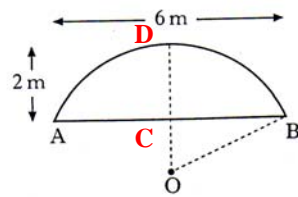
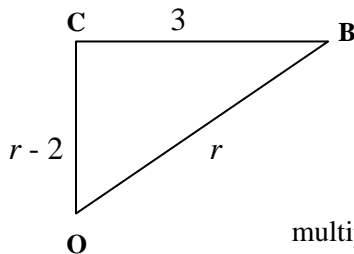


Figure 2



By Pythagoras:

$$r^2 = (r - 2)^2 + 3^2$$

multiply out the brackets

$$r^2 = r^2 - 4r + 4 + 9$$

Bring all terms in r to left hand side:

$$r^2 - r^2 + 4r = 13 \quad \text{hence} \quad 4r = 13$$

So, $r = 3.25$ metres.

6. Similar Triangles

a) First find the linear scale factor to large bottle:

$$\frac{\text{large bottle}}{\text{small bottle}} = \frac{9}{6} = \frac{3}{2}$$

We are working with volume,
so the scale factor is **CUBED**.

Hence **Volume scale factor** is $\frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} = \frac{27}{8}$

i) Volume of larger bottle:

$$30 \times \frac{27}{8} = 101.25 = 101 \text{ mls}$$

ii) This time we are finding **area** of small one,

So, linear scale factor to small bottle is: $\frac{2}{3}$

so scale factor is **SQUARED**,

$$\text{Area small bottle} = 180 \times \frac{2}{3} \times \frac{2}{3} = 80 \text{ cm}^2$$

b) First find the linear scale factor to small box:

$$\frac{\text{small box}}{\text{large box}} = \frac{50}{60} = \frac{5}{6}$$

We are working with area,
so the scale factor is **SQUARED**.

Hence **Area scale factor** is $\frac{5}{6} \times \frac{5}{6} = \frac{25}{36}$

Amount of paint required:

$$3.4 \times \frac{25}{36} = 2.3611... = 2.4 \text{ litres.}$$

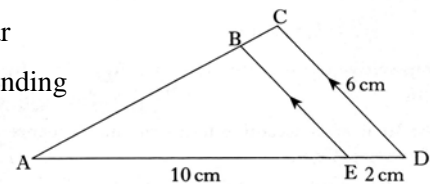
c) Triangles are similar

So ratio of corresponding sides are the same

We want BE , so

$$\frac{BE}{CD} = \frac{AE}{AD} \rightarrow \frac{BE}{6} = \frac{10}{12} \rightarrow BE = \frac{10}{12} \times 6$$

Hence $BE = 5$ cm.



d) As above:

$$\frac{CD}{AB} = \frac{EC}{AE} \rightarrow \frac{CD}{8.4} = \frac{3}{4.5} \rightarrow CD = \frac{3}{4.5} \times 8.4$$

Hence $CD = 5.6$ metres