Paper 1 June 2021

1) $(a^5)^3 = a^{15}$

2) $x \neq 0.4$

$\frac{4}{10} = 0.4$ ✗

$\frac{20}{50} = \frac{40}{100}$ ✗

$\frac{120}{300} = \frac{40}{100}$ ✗

so it must be $\frac{26}{70}$

We could have spotted this immediately by noting that 26 does not have 7 as a factor.

3) Vertices are "corners"

Hexagon based pyramid. is correct.

4) The graph is $\frac{k}{x}$

We need to recognise linear, quadratic, exponential and inverse graphs.

5) $200 = 100 \times 2$
$= 50 \times 4$
$= 25 \times 8$
$= 5^2 \times 2^3$

This is the quickest approach.

6) Lily is 28 months
Hugo is 20 months

so $\frac{28}{20} = \frac{7}{5} = 1\frac{2}{5}$

Personally I think $\frac{7}{5}$ is "simpler" than $1\frac{2}{5}$ but the examiner wants to see the latter. When in doubt give both answers.

7) $\frac{\sqrt{47 + 2.014^3}}{0.49}$

$= (10 + 2^3) \times 2$

$= 18 \times 2$

$= 36$

8) $5x + 6 > 3x + 15$

Treat inequalities as equalities excepting two rules.

If you multiply through by -1 then flip the inequality sign.

If you flip over the expression then flip the inequality sign.

so $5x + 6 > 3x + 15$

$\Rightarrow 3x + 15 < 5x + 6$

$(5x - 3x) > 15 - 6$

$2x > 9$

$x > 4\frac{1}{2}$

9) If we move the axis to align with the lines of symmetry then recognise that now if P (a, b) then Q $(-a, -b)$ then move axis back.

so $(-2, -6) - \begin{bmatrix} 1 \\ 5 \end{bmatrix} = (-3, -11)$

$(-3, -11) \rightarrow (3, 11)$

$(3, 11) + \begin{bmatrix} 1 \\ 5 \end{bmatrix} = (4, 16)$

This however is tricky and it is better done by simple inspection. This technique though is worth remembering for later topics.

10 a) 2000×70000

$= 2 \times 7 \times 10^7$

$= 14 \times 10^7$

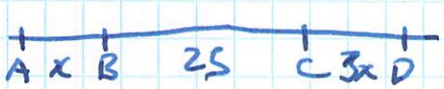
$= 1.4 \times 10^8$

b) $\dfrac{1.8 \times 10^2}{3 \times 10^{-1}}$

$= 0.6 \times 10^3$

$= 600$

11)



62 miles/hour for 30 min is 31 miles.

So $x + 25 = 31$

$x = 6$ miles

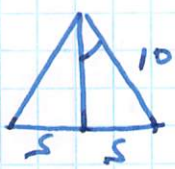
So AD $= 25 + 4 \times 6$

$= 49$ miles

Not too difficult with a clear diagram and careful thinking.

12) $\sin 30 = \dfrac{x}{10}$

but this is a non calculator paper so we have to decide $\sin 30$.



think of an equilateral triangle. It's immediately obvious that

$x = 5$

13) $\dfrac{5}{6}$ as decimal.

$$6 \overline{)5.0_2 0_2 0} \quad .833\ldots$$

$\dfrac{5}{6} = 0.8\dot{3}$

14) $\dfrac{3}{x} + \dfrac{4}{x} = \dfrac{3+4}{x}$

$= \dfrac{7}{x}$

15) $(x + a)(x + 3a) = x^2 + bx + 75$

Now equating x^0 terms

$3a^2 = 75$

so $a = \pm 5$

$(x + 5)(x + 15)$

$= x^2 + 20x + 25$

$(x - 5)(x - 15)$

$= x^2 - 20x + 75.$

So b term is ± 20

16) Cumulative frequency curve

at mass 21 gram read off 16

So no. purchased $= 40 - 16$

$= 24$

b) Draw boxplot where

lowest = 3

LQ = 18

Median = 22

UQ = 24

Highest = 28

17) $(-2,7) + \begin{bmatrix} a \\ b \end{bmatrix} = (3,-1)$

so $\begin{bmatrix} a \\ b \end{bmatrix} = (3,-1) - (-2,7)$

$= \begin{bmatrix} 5 \\ -8 \end{bmatrix}$

18 $AB < AC + CB$

$AB < 17 + 13$

$AB < 30$

so $AB \neq 35$

18b) Leah has confused angles with sides

She should have written

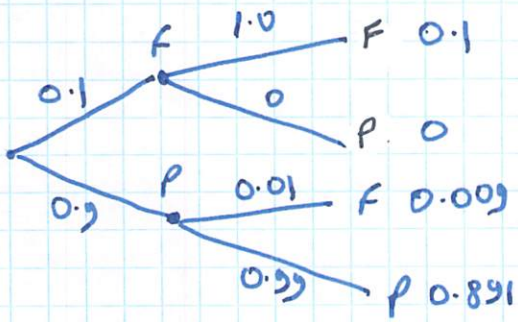
$$\frac{\sin x}{31} = \frac{\sin 72}{54}$$

$$\sin x = \frac{31 \sin 72}{54}$$

$$x = \sin^{-1}\left[\frac{31 \sin 72}{54}\right]$$

The question doesn't actually ask you to calculate this.

19.



Think of the diagrams as

The OR vertical axis must add to 1.
The AND horizontal axis we multiply. It's the x axis !!

b) $P(\text{fail}) = 0.1 + 0.009$

$= 0.109$

20) Density is mass/unit volume

grams/cm^3

21) There is a standard method for working out the n^{th} term of a quadratic sequence. Learn it!

0	1	2	3	4
9	10	17	30	49
	1	7	13	19
		6	6	6

We need these values to define the quadratic

let $f(n) = ax^2 + bx + c$

a is half the constant in the third line.

a+b+c = the 1st term

c is the value under 0^{th} term.

so $a = 3$

$a+b+c = 10$

$c = 9$

so $b = -2$

and n^{th} term is

$3n^2 - 2n + 9$

22) $\left(\frac{5}{7}\right)^{-2} = \left(\frac{7}{5}\right)^2 = \frac{49}{25}$

$= 1\frac{24}{25}$

This is called a mixed number

23) $y = \frac{1}{\sqrt{x+1}}$

$\sqrt{x+1} = \frac{1}{y}$

$x+1 = \frac{1}{y^2}$

$x = \frac{1}{y^2} - 1$

$= \frac{1-y^2}{y^2}$

24) $f(x) = cx+d$

$f(4) = 7$

$f(10) = 22$

We could solve this by simultaneous equations

$7 = 4c + d$ ①

$22 = 10c + d$ ②

deduct ① from ② to eliminate d

$15 = 6c$

$c = 2\frac{1}{2}$

and substituting back into ①

$7 = 10 + d$

$d = -3$

However the coefficients are not so large that we could take a direct approach.

0 1 2 3 4 5 6 7 8 9 10

7 22

so we have to get from 7 to 22 in 6 jumps. So $c = \frac{22-7}{6}$

$= 2\frac{1}{2}$.

Now we jump back 4 to get the 0th term which is −3

and −3 and $2\frac{1}{2}$ are the values required.

$f(x) = 2\frac{1}{2}x - 3$

jumping number — what we get for free

24 b) $g(x) = 2x$

$h(x) = \frac{x-1}{2}$

$hg(x)$ means $h\{g(x)\}$

so we put $g(x)$ where we have an x in $h(x)$

$hg(x) = \frac{2x-1}{2}$

{ Students will often get this back-to-front. So they start with $2x$ and then substitute $\frac{x-1}{2}$ for x to get

$\frac{2(x-1)}{2} = x-1$

That's why the examiner "hooks" the student by giving $x-1$ as one of the options }

25) $\frac{\sqrt{150} - \sqrt{6}}{\sqrt{2} \times \sqrt{3}}$

$= \frac{\sqrt{25 \times 6} - \sqrt{6}}{\sqrt{6}}$

$= \frac{\sqrt{6}\sqrt{25} - \sqrt{6}}{\sqrt{6}}$

$= \frac{5\sqrt{6} - \sqrt{6}}{\sqrt{6}}$

$= \frac{4\sqrt{6}}{\sqrt{6}}$

$= 4$

There are two rules here, one the inverse of another.

If c has factors a and b

$\sqrt{c} = \sqrt{ab} = \sqrt{a} \times \sqrt{b}$

The inverse rule is

$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

we can combine the roots into one.

26) $d = 2f$

if $\frac{e-f}{d-e} = \frac{1}{4}$

eliminate the d by substituting $2f$

$\Rightarrow \frac{e-f}{2f-e} = \frac{1}{4}$

$4e - 4f = 2f - e$

$5e = 6f$

$e : f \Rightarrow 6 : 5$

Note we reversed 6 and 5.
Think carefully about this.
If we started with

$e : f$

$6 : 5$

which is the bigger?

27) The shaded area is called a segment.

Area segment = area sector − area triangle.

This is a standard formula which we're not given so we'll have to work it out from first principles.

First we draw a reminder Δ

So we recall $\sin 60° = \frac{\sqrt{3}}{2}$

Area $\Delta = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \times 5 \times 5 \times \frac{\sqrt{3}}{2}$

Area sector $= \frac{1}{6}$ area circle

$= \frac{1}{6} \pi 5^2$

So shaded $= \frac{25}{6}\pi - \frac{25}{4}\sqrt{3}$

$= \frac{50}{12}\pi - \frac{75}{12}\sqrt{3}$

$= \frac{50 - 25\sqrt{3}}{12}$

28) a)

$\cos(x - 90°)$ shifts the function 90° to the right

$\cos x + 1$ shifts the function 1 unit up.

If you have a graphical calculator experiment with these functions.

In c) Rita has drawn $-\cos x$

In fact $\cos(-x) = \cos x$ because cos is an even function.

It reflects in the x-axis.

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29. In the exam you can ask for tracing paper. If there is a transformation question the invigilator will often just hand out the tracing paper BUT THEY ARE NOT SUPPOSED TO! You're supposed to ask for it.

The transformation here is enlargement −1 centre (−1, 1)

Alternatively consider it a rotation about −1, 1 which is why B stays invariant - it doesn't move.
