

Paper 2 June 2021

1) $x^2 - 5x = x(x - 5)$

because x occurs in every term so we can "take it out"

2) $A = \frac{1}{2}B$

$2A = B$

$A : B$

$1 : 2$

3) $\frac{2}{3} \times \frac{2}{3} \times \frac{4}{9} \times \frac{2}{3} \times \frac{8}{27}$

$\frac{8}{27} \times \frac{2}{3} = \frac{16}{81}$

4) Triangle congruency is SSS

5) Solve $10x = 62.4 - 3x$

$13x = 62.4$

$x = 4.8$

6) Concentrate on that central quadrilateral

1st angle is 52°

clockwise

2nd angle is $180 - 110 = 70^\circ$

3rd angle is $\frac{360 - 2 \times 49}{2}$

$= 131$

or I could just have said

$180 - 49 = 131^\circ$

so 4th internal angle is

$360 - 52 - 70 - 131$

$= 107^\circ$

so $x = 180 - 107$

$= 73^\circ$

so I didn't even make use of the fact that $A \parallel B$.

Strange question. Even the examiner's report doesn't mention this. It says "few students got this correct"

7) Mean Mark All

$= \frac{102 \times 68.5 + 85 \times 72.4}{102 + 85}$

$= 70.27$

So Answer is Yes $70.27 > 70$

8) The single transformation is

Enlargement $\frac{1}{2}$ Centre (3, 9)

Remember the examiner needs to see all 3 pieces of information.

9) Volume sphere = $\frac{4}{3} \pi 15^3$

$= 14137$

Remaining air needed

$14137 - 5000$

$= 9137 \text{ cm}^3$

Time taken = $9137 / 160$

$= 57 \text{ sec.}$

So it does take less than a minute.

10) p is positive n is negative

$p + n$ positive?

sometimes

$p - n$ positive?

always

$p^2 + n^2$ positive?

always

$p^3 \div n^3$ positive

never.

To get a handle on this sort of question try a few examples $p > n$ $p < n$ $p = n$ for simple values like 1 and 2.

11) Complete the relative frequency graph.

come on! This question is a give away.

b) Best estimate probability train late is just the final relative frequency

$P(\text{late}) = \frac{55}{250} = 0.22$

12) $5x + 40 + 2(2x + 20) + x = 360^\circ$

collect terms $10x + 80 = 360$

$10x = 280$

$x = 28$

so $5x + 40 = 180^\circ$

so AC is a diameter

- 13) This is a standard question solved by the equation

$$y - y_1 = m(x - x_1) \text{ learn!}$$

$$y - 13 = 6(x - 3)$$

$$= 6x - 18$$

$$y = 6x + 1$$

$$\text{check } 13 = 6 \times 3 + 1 \checkmark$$

- 14) Population = 4200

$$\text{New population is } 4200 \times 1.12^{20}$$

$$= 40514$$

$$> 40000$$

So demonstrated.

Why does the examiner set questions like this. I suppose to give you a hint that if you're used to taking the wrong method you know to try something else.

- b) New population is

$$4200 \times 1.13^{19} \times 0.92$$

$$= 39402$$

$$39402 < 40000 \text{ so } \underline{\text{No}}$$

- c) $P(\text{less than 21}) = 0.4$

$$30 \times 0.4 = 12 \text{ days}$$

so we have $12 \times 700 + 18 \times 900$

$$\text{expected visitors} = 24600$$

- 15) This is a standard question. learn!

$$L \propto D^2$$

$$\text{replace } D \text{ with } = k$$

$$L = kD^2$$

insert the values given to find k .

$$85 = k10^2$$

$$k = 0.85$$

$$\text{so } L = 0.85D^2$$

- b) Use this expression to find one value when given another.

$$L = 0.85 \cdot 5^2$$

$$= 21.25$$

16. Pythagoras' "work" in any number of dimensions

$$\text{so for a square } h^2 = x^2 + x^2$$

$$\text{cube } d^2 = x^2 + x^2 + x^2$$

etc.

$$\text{so for a cube } d^2 = 3x^2$$

$$d = \sqrt{3x^2}$$

$$d = \sqrt{3} \times \sqrt{x^2}$$

$$d = \sqrt{3}x$$

- b) Cube has 12 edges

$$\text{so total} = 12x$$

$$\text{i.e. } 12x = 18n$$

$$x = \frac{3}{2}n$$

if the word "multiple" of - 18 includes 18 itself then the correct answer is

x might be a whole number.

- 17) $P(\text{laptop/male}) = \frac{2}{11}$

$$P(\text{laptop/female}) = \frac{4}{9}$$

so $P(\text{exactly one said laptop})$

$$= \frac{2}{11} \times \frac{5}{9} + \frac{9}{11} \times \frac{4}{9}$$

$$= (10 + 36)/99 = \underline{\underline{46/99}}$$

$$P(2 \text{ males said "phone"})$$

$$= \frac{9}{11} \times \frac{8}{10} = \frac{72}{110} = \underline{\underline{\frac{36}{55}}}$$

Remember we are choosing from a fixed population so when we have chosen the first male we have one fewer for the second choice.

Questions that imply AND we multiply the probabilities

Questions that imply OR we add the probabilities

- 18) Remember we use
dotted lines to indicate $<$
solid lines to indicate $\leq$

$$x \leq 5$$

vertical solid line shade left

$$y \leq 4$$

horizontal solid shade below

$$x + y > 6$$

draw a line from $(0, 6)$ to $(6, 0)$
Shade this dotted line

If we shade the areas differently
say $|||$ $\equiv$ $///$

then we identify the area with
all three shadings.

In this case we readily identify
a triangle without need for
separate shading.

- 19) This curve is known as
a parabola and has the
equation of a quadratic

The rocket is in the air from
4 sec. to 10 sec.

$$\text{Time} = 10 - 4 = 6 \text{ seconds.}$$

To find the speed draw a
tangent at 6 seconds and
measure the gradient.

The examiner will accept any
reasonable answer as long as
the calculation matches your
readings.

Choose 2 points on your line
well spaced and easy to read off

Now as an extension task we
can indulge in a bit of higher maths.

The equation is $-(x-7)^2 + 9 = 0$

which multiplies out to give
 $-x^2 + 14x - 40 = 0$

can you see why?

Now using calculus (the converse
that all the needs sign up for in
RomComs to denote they are clever
but in fact it's all very straight forward)

gradient at any value x
 $= -2x + 14$

So gradient at $x=6$ is "2"

Now to draw a line gradient 2
is just the next diagonal across
each thick line square.

So the examiner has made this
really easy for you.

So speed rocket = gradient tangent
 $= 2 \text{ metres/second.}$

$$20) 0.25 \text{ m}^2 \times 100 \frac{\text{cm}}{\text{m}} \times 100 \frac{\text{cm}}{\text{m}}$$

$$= 2500 \text{ cm}^2$$

$$\sqrt{2500} = 50 \text{ cm}$$

- 21) This is a standard question.
Learn the technique

$$35 + (3x+1)^2 - 2x(4x-3)$$

When we multiply this out we're
expecting that all the x terms
will cancel out and the final
answer will be a square number.

$$35 + 9x^2 + 6x + 1 - 8x^2 + 6x$$

$$= x^2 + 12x + 36$$

Now that isn't what we were
expecting but don't let's let
our nerve. Is this a square?

$$x^2 + 12x + 36 = (x+6)^2$$

It is!

So we have proved that for
all values of x , the expression
reduces to a square number.

22) 3 digit code

First digit cube.

So it could be 1 or 8

2nd digit factor 16

So it could be 1, 2, 4, 8

3rd digit is odd

So it could be 1 3 5 7 9

(the examiner purposely doesn't say "even" because we don't then have to address the issue as to whether 0 is even.)

So possible permutations are

$$2 \times 4 \times 5 = 40$$

Not permutations are when order matters and combinations are when order doesn't matter. So a combination lock should really be called a permutation lock. This is why the examiner avoids the term altogether.

$$P(\text{correct code}) = \frac{1}{40}$$

23)

This is the cosine rule.

We need to know $\angle PQR$

$$\angle PQR = (180 - 155) + 80 = 105^\circ$$

Can you see why? If not, extend line NQ downward and have a close look.

From here it's just a calculation.

$$PR^2 = 12^2 + 28^2 - 2 \times 12 \times 28 \times \cos 105^\circ$$

Footprint technique is

$$12^2 + 28^2 = \text{Ans.}$$

$$\text{Ans} - 2 \times 12 \times 28 \times \cos 105^\circ = \text{Ans.}$$

$$\sqrt{\text{Ans}} = 33.2 \text{ miles}$$

24)

	Dist.	Speed	Time
1st.	731	x	$731/x$
2nd	287	$x-24$	$287/(x-24)$

if the flight lasted 2 hours
we just set up the equation

$$\frac{731}{x} + \frac{287}{x-24} = 2$$

Multiply through by $x(x-24)$

$$731(x-24) + 287x = 2x(x-24)$$

$$731x - 24 \cdot 731 + 287x = 2x^2 - 48x$$

collect terms and we get

$$x^2 - 533x + 8712 = 0$$

Now incredibly this will factorise into

$$(x-17)(x-516) = 0$$

but who will ever spot that? This is the examiner having a joke at your expense.

Normally we'd just use the formula. I'll leave that as an exercise for the student.

$$\text{We discard } x=17 \text{ and } x=516$$

25)

$$y = x^2 + 14x + 52$$

$$= (x+7)^2 - 49 + 52$$

$$= (x+7)^2 + 3$$

so the turning point is at $(-7, 3)$