

Do not write outside the box

23 Quadrilateral ABCD is reflected in edge BC.

How many of the vertices are invariant?

Circle your answer.

ca B don't move

A B

D C

1 2 0 4

[1 mark]

24 Write $2x^2 - 12x + 7$ in the form $d(x+e)^2 + f$ where d , e and f are integers.

[3 marks]

Try $(x-6)^2 = x^2 - 12x + 36$
but we need factor 2
so try $2(x-3)^2 = 2x^2 - 12x + 18$
so $f(x) = 2(x-3)^2 - 11$

Answer

$$d = 2 \quad e = -3 \quad f = -11$$

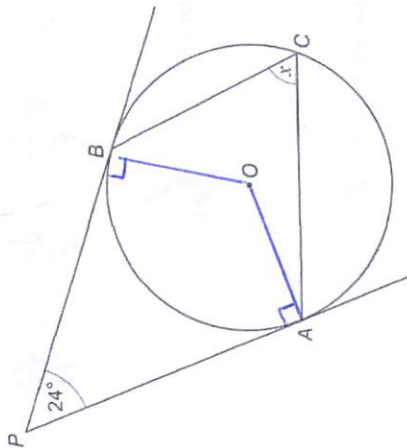
END OF QUESTIONS



22

A, B and C are points on a circle, centre O.
AP and BP are tangents to the circle.

Not drawn accurately



Work out the size of angle x.

[3 marks]

Quadrilateral PBOA

$$PBO = OAP = 90^\circ$$

$$\text{so } BOA = 360^\circ - 180^\circ - 24^\circ = 156^\circ$$

$$\text{so } x = 156/2 = 78^\circ$$

Answer

Turn over



- 23 (a) The first three terms of a geometric progression are

$$\frac{\sqrt{5}}{2}, \frac{5}{4}, \frac{5\sqrt{5}}{8}$$

Work out the next term.

[1 mark]

$$\times \frac{\sqrt{5}}{2} \text{ so } \frac{5\sqrt{5}}{8} \times \frac{\sqrt{5}}{2} = \frac{25}{16}$$

Answer

$$\frac{25}{16}$$

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- 23 (b) The
- n
- th term of a sequence is
- $(2 + \sqrt{3})^n$

Show that the third term is $26 + 15\sqrt{3}$

[3 marks]

$$\begin{aligned} (2 + \sqrt{3})^2 &= 4 + 4\sqrt{3} + 3 \\ &= 7 + 4\sqrt{3} \\ (7 + 4\sqrt{3})(2 + \sqrt{3}) &= 14 + 8\sqrt{3} + 7\sqrt{3} + 4 \times 3 \\ &= 14 + 8\sqrt{3} + 7\sqrt{3} + 12 \\ &= 26 + 15\sqrt{3} \end{aligned}$$

$$26 + 15\sqrt{3}$$

- 21 (b) A different cylinder has radius
- $3r$
- and height
- $2h$
- .

How many times bigger is the volume of this cylinder than the volume of C?

[2 marks]

$$Vol_{new} = V_{old} \times 3^2 \times 2 = 18$$

Answer

$$18$$

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- 22

Fatima is choosing a 4-digit code.

Each digit is a whole number from 0 to 9

She decides

all her digits will be odd numbers

no digits will be repeated.

How many different codes can she make?

[2 marks]

$$1st \ 2nd \ 3rd \ 4th$$

$$13579$$

$$5 \times 4 \times 3 \times 2 = 120$$

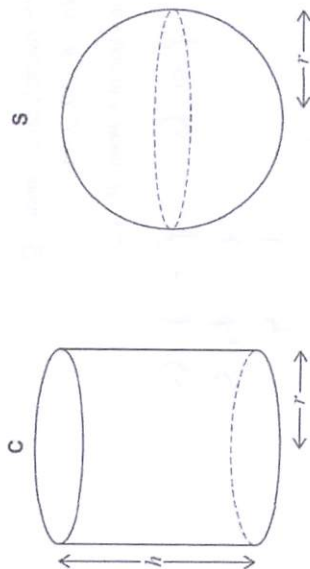
Answer

$$120$$

Turn over ►



- 21 A cylinder, C, and a sphere, S, each have radius r .
C has height h .



Volume of a sphere = $\frac{4}{3}\pi r^3$
where r is the radius

- 21 (a) volume of C = volume of S

Work out the ratio $r : h$

You must show your working.

$$\pi r^2 h = \frac{4}{3} \pi r^3$$

$$h = \frac{4 \pi r^3}{3 \pi r^2}$$

$$3h = 4r \quad \text{or} \quad 4r = 3h$$

$$\text{so } r : h = 3 : 4$$

Answer

$$3:4$$

Note 'never'

[3 marks]

- 24 (a) $9k + 7$ and $2k^2 + 3$ are consecutive integers.
 $9k + 7$ is the smaller integer.

Work out the value of the next consecutive integer.

[5 marks]

$$(9k+7)+1 = 2k^2+3$$

$$9k+8 = 2k^2+3$$

$$2k^2-9k-5=0$$

$$(2k+1)(k-5)=0$$

$$\text{so } k = 5 \quad (\text{discard negative})$$

$$2k^2+3 = 53$$

$$\text{Next integer} = 54$$

Answer

$$54$$

- 24 (b) x is a square number.

Show that the next square number is $x + 2\sqrt{x} + 1$

[2 marks]

the number squared to make x is $\sqrt{x}$
so next number after $\sqrt{x}$ is $\sqrt{x}+1$

$$\begin{aligned} (\sqrt{x}+1)^2 &= (\sqrt{x}+1)(\sqrt{x}+1) \\ &= x + 2\sqrt{x} + 1 \end{aligned}$$

Turn over

25

Show that the value of $6 \sin 30^\circ + 2 \cos 30^\circ \times 4 \tan 30^\circ$ is an integer.

[4 marks]

$$\sin 30^\circ = \frac{1}{2}$$

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$\tan 30^\circ = \frac{1}{\sqrt{3}}$$

$$\text{Expression} = 6 \times \frac{1}{2} + 2 \times \frac{\sqrt{3}}{2} \times \frac{4}{\sqrt{3}}$$

$$= 3 + 4$$

$$= 7$$

END OF QUESTIONS

4

20

P , Q , and R have positive values.

P is directly proportional to Q

When $P = 8$, $Q = 2$

R is inversely proportional to Q^2

When $R = 10$, $Q = 3$

Work out the value of R when $P = 0.5$

[5 marks]

$$P \propto Q$$

$$P = k_1 Q$$

$$8 = k_1 \cdot 2$$

$$k_1 = 4$$

$$R \propto \frac{1}{Q^2}$$

$$10 = \frac{k_2}{3^2}$$

$$k_2 = 90$$

$$\text{so } 0.5 = 4Q \quad \text{so } Q = \frac{1}{8}$$

$$R = \frac{90}{(\frac{1}{8})^2}$$

$$= 5760$$

$$R = 5760$$

Turn over for the next question

11



24

IB/M/Jun/24/6300/1H



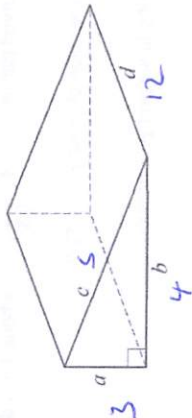
23

IB/M/Jun/24/6300/1H

Turn over ►

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25 Here is a right-angled triangular prism.



The ratio of the edges is $a : b : c : d = 3 : 4 : 5 : 12$

The volume of the prism is 1125 cm^3

Work out the total length of all of the edges of the prism.

[5 marks]

$$\begin{aligned} \text{Vol} &= \frac{1}{2} \times 3 \times 4 \times 12 \\ 1125 &= 72x \\ x &= 15.625 \end{aligned}$$

$$\begin{aligned} \text{So length all sides} &= \left[(3+4+5) \times 2 \right] \times 12 \\ &= (12 \times 2 + 3 \times 12) \times 12 \\ &= 60 \times 12 \\ &= 720 \end{aligned}$$

Answer 150 cm

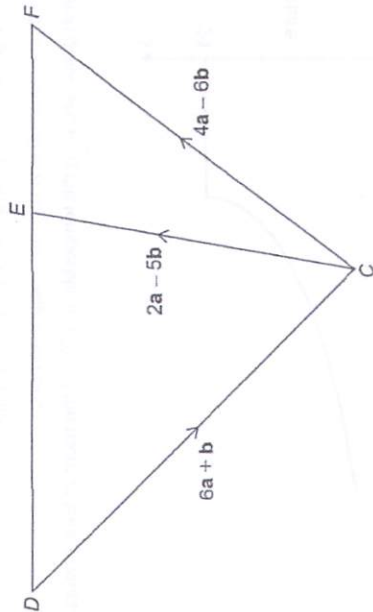
END OF QUESTIONS



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23

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Prove that DEF is a straight line.

[4 marks]

$$\begin{aligned} \vec{DE} &= \vec{DC} + \vec{CE} \\ &= 6a + b + 2a - 5b \\ &= 8a - 4b \end{aligned}$$

$$\begin{aligned} \vec{CE} + \vec{CF} &= -\vec{FC} \\ \vec{CE} &= \vec{CE} - \vec{FC} \\ &= 2a - 5b - 4a + 6b \\ &= -2a + b \\ \vec{FE} &= 2a - b \end{aligned}$$

$$\text{Now } \vec{DE} = k \vec{FE}$$

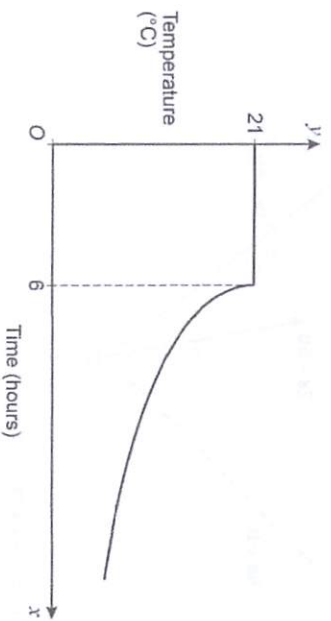
So lines have same gradient
point E is common

So DEF is straight line -

Turn over

24

A room is kept at a constant temperature of 21°C for 6 hours. The heating is then turned off and the room begins to cool. Here is a sketch graph showing the temperature, $y^{\circ}\text{C}$, of the room at time x hours.



24 (a)

Assume the equation of the curved part is $y = \frac{k}{x}$ where k is a constant.

Work out the value of y when $x = 12$

[2 marks]

$$y = \frac{k}{x}$$

$$21 = \frac{k}{6}$$

$$k = 21 \times 6 = 126$$

$$f(12) = \frac{126}{12}$$

$$= 10\frac{1}{2}^{\circ}\text{C}$$

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24 (b)

In fact,

the equation of the curved part is $y = A \times \left(\frac{1}{3}\right)^{\frac{1}{6}x}$ where A is a different constant.

How does this affect the value of y when $x = 12$?

Tick **one** box.

You must show working to support your answer.

[2 marks]

☐

The value of y is greater than the answer to part (a).

☒

The value of y is less than the answer to part (a).

☐

The value of y is the same as the answer to part (a).

$$21 = A \times \left(\frac{1}{3}\right)^{6/6}$$

$$A = 63$$

$$\text{at } f(12) = 63 \times \left(\frac{1}{3}\right)^2$$

$$= 7^{\circ}$$

Turn over for the next question

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