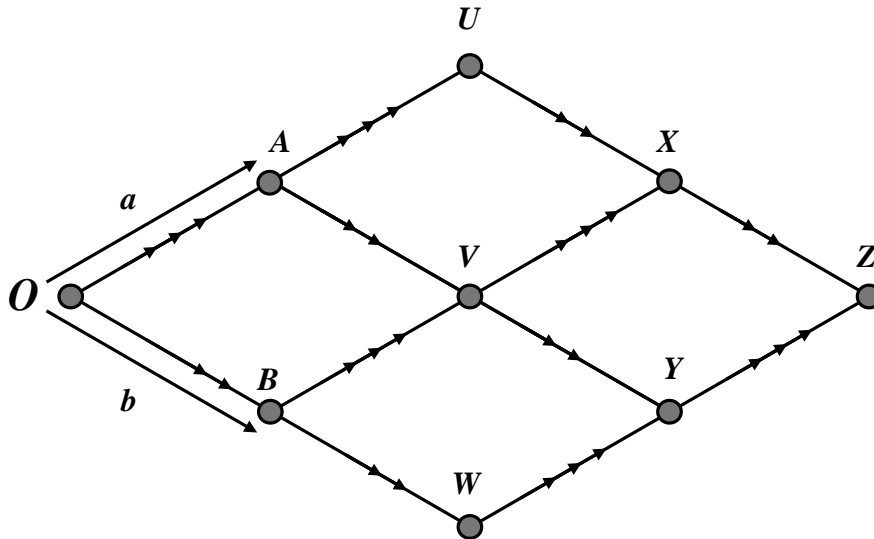


Grade Grabber 4

Marks Available: 40

Question 1

In the diagram below four congruent rhombuses are shown.



If the vectors $\vec{OA} = \vec{a}$ and $\vec{OB} = \vec{b}$ write down in terms of \vec{a} and \vec{b} the vectors:

(i) \vec{OZ}

[1 mark]

(ii) \vec{UB}

[1 mark]

(iii) \vec{XA}

[1 mark]

(iv) Given that $\vec{OZ} = k \vec{XA}$ state the value of the constant k

[2 marks]

(v) What does your part (iv) result tell you about \vec{OZ} and \vec{XA} ?

[1 mark]

Question 2

Lead is one of the most dense metals with a density of 11340 kg m^{-3}
Blocks of it are used to shield nuclear reactors in power stations.

- (i) Find the volume in m^3 of a block of lead measuring $1.5 \text{ m} \times 1.5 \text{ m} \times 0.2 \text{ m}$

[1 mark]

- (iii) Use the formula

$$\text{Mass} = \text{Density} \times \text{Volume}$$

to find the mass of the block of lead, in kg

[1 mark]

- (iv) As $1000 \text{ kg} = 1 \text{ tonne}$, give the mass of the block in tonnes

[1 mark]

- (v) Could you lift this block of lead ?

[1 mark]

Question 3

$$A = \{ \text{factors of } 16 \}$$

$$B = \{ \text{factors of } 20 \}$$

List the elements of :

- (i) A

[1 mark]

- (ii) B

[1 mark]

- (iii) $A \cap B$

[1 mark]

- (iv) $A \cup B$

[1 mark]

- (v) $A' \cap B$

[1 mark]

- (vi) $A \cap B'$

[1 mark]

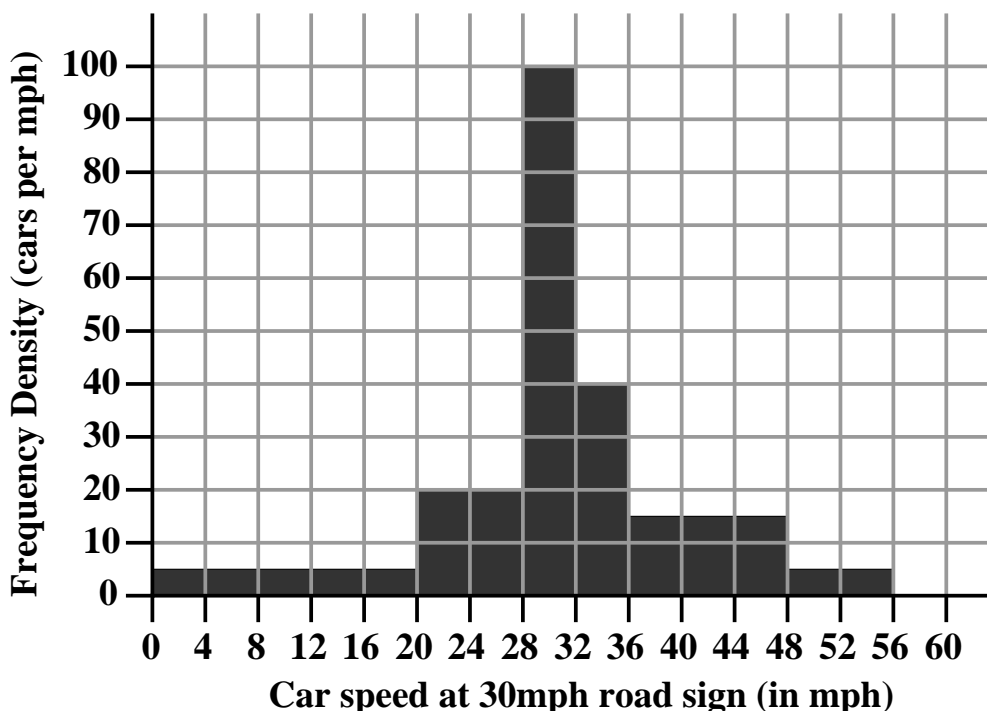
- (vii) $(A' \cap B) \cap (A \cap B')$

[1 mark]

Question 4

In trying to decide if a speed camera is required in the town of Numberville, a consultant provides the following histogram which shows the distribution of car speeds as cars pass the 30 mph sign heading into Numberville.

A histogram to show the distribution of car speeds at a 30mph road sign



(i) Use the histogram to complete the following table :

Car speed (miles per hour, mph)	Number of cars Frequency = Area	Width	Height
$0 \leq m < 20$			
$20 \leq m < 28$			
$28 \leq m < 32$			
$32 \leq m < 36$			
$36 \leq m < 48$			
$48 \leq m < 56$			

[3 marks]

(ii) How many cars in total had their speed recorded entering Numberville ?

[2 marks]

(iii) What percentage of cars were travelling within 2mph of the speed limit ?

[2 marks]

Question 5

An iPad costs £320 *after* a discount of 20% has been applied.
What was its price *before* the discount was applied ?

[2 marks]

Question 6

Differentiate :

$$y = 4x^3 + 5\sqrt{x}$$

[3 marks]

Question 7

Simplify;

$$\frac{x^2 - 2x - 24}{x^2 - 36}$$

[2 marks]

Question 8

A circle has equation;

$$x^2 + y^2 = 100$$

and a line has equation;

$$x = 3y - 10$$

Find the coordinates of the two points where the line intersects the circle.

[5 marks]

Question 9

- (i) Before it is sharpened, a pencil is a cylinder 15 cm long with a diameter of 0.6 cm. What is its volume ?
- (ii) It is now sharpened, so that the last 2cm of the pencil forms a cone. How much volume has been lost.

$$V_{prism} = Area\ of\ Base \times Height$$

(A cylinder is a prism with a circular base)

$$V_{pyramid} = \frac{Area\ of\ Base \times Height}{3}$$

(A cone is a pyramid with a circular base)

[4 marks]

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In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

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Teachers may obtain detailed worked solutions to the exercises by email from mhh@shrewsbury.org.uk