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Phone: +442081445350

www.chemistryonlinetuition.com

Email:asherrana@chemistryonlinetuition.com

PURE MATH

ALGEBRA AND FUNCTION

Level & Board	EDEXCEL (A-LEVEL)
TOPIC:	ARITHMETIC SEQUENCE
PAPER TYPE:	SOLUTION - 1
TOTAL QUESTIONS	8
TOTAL MARKS	56

Q.1

To find the fastest speed of a car in the 3rd gear in an arithmetic sequence, you can use the formula for the nth term of an arithmetic sequence:

$$an = a1 + (n-1)d$$

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

d is the common difference between successive terms.

Given that the speed in 1st gear (a1) is 28 km/h, and the speed in 6th gear (a6) is 115 km/h, you can find the common difference (d) by using the formula:

$$d = (a6 - a1) / (6 - 1)$$

$$d = 87.5 / 5$$

$$d = 17.5$$

Now, you can use this common difference to find the speed in the 3rd gear (a3):

$$a3 = a1 + (3-1)d$$

$$a3 = 28 + 2x17.5$$

$$a3 = 28 + 35$$

$$a3 = 63 \text{ km/h}$$

So, the fastest speed of the car in the 3rd gear is 63 km/h.

(b)To find the fastest speed of the car in the 5th gear in a geometric sequence, you can use the formula for the nth term of a geometric sequence:

$$an = a1 \times r^{(n-1)}$$

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

r is the common ratio between successive terms.

Since you are given that the sequence is geometric, you need to find the common ratio (r). The common ratio is given by:

r = (a5 / a6)

Given that the speed in 6th gear (a6) is 115 km/h and the speed in 5th gear (a5) is not given, you cannot directly calculate r. However, you can use the fact that the sequence is arithmetic to find a5.

Using the arithmetic sequence formula:

a5 = a1 + 4d

where d is the common difference calculated in part (a). Substitute the known values:

a5 = 28 + 4x17.5

a5 = 28 + 70

a5 = 98 km/h

Now that you have a5, you can find the common ratio r:

r = (a5 / a6)

r = 98 / 115

r ≈ 0.8522

Now, you can use the common ratio to find the speed in the 5th gear (a5):

a5 = a1 x r^(5-1)

a5 = 28 x 0.8522^4

a5 ≈ 41.5 km/h

So, the fastest speed of the car in the 5th gear is approximately 41.5 km/h.

Q.2

(a) Using the arithmetic sequence formula:

an = a1 + (n-1)d

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

d is the common difference between successive terms.

First, we need to find the common difference (d):

d = (a5 - a1)/(5 - 1)

d = (120 - 20)/4

d = 25

Now, we can find the speed in the 3rd gear (a3):

a3 = a1 + (3-1)d

a3 = 20 + 2x25

a3 = 70 km/h

So, the speed in the 3rd gear is 70 km/h.

(b) Moving on to the geometric sequence:

an = a1 x r^(n-1)

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

r is the common ratio between successive terms.

First, we need to find the common ratio (r):

r = a4/a5

Given that the speed in the 5th gear (a5) is 120 km/h and the speed in the 4th gear (a4) is not given, let's say a4 = 90 km/h for this example.

r = 90/120

r = 3/4

Now, we can find the speed in the 4th gear (a4):

a4 = a1 x r^(4-1)

a4 = 20 x (3/4)^3

a4 ≈ 48.89 km/h

So, the speed in the 4th gear is approximately 48.89 km/h.

Q.3

(a) To find the speed in the nth gear using arithmetic sequence formula, we can use the formula:

an = a1 + (n-1)d

where:

an is the speed in the nth gear

a1 is the speed in the 1st gear

n is the gear number

d is the common difference between successive terms.

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First, we need to find the common difference (d):

d = (a7 - a1) / (7 - 1)

d = (150 - 30) / 6

d = 20

Now, we can find the speed in the 4th gear:

a4 = a1 + (4-1)d

a4 = 30 + 3*20

a4 = 90 km/h

So, the speed in the 4th gear is 90 km/h.

(b) To find the speed in the nth gear using geometric sequence formula, we can use the formula:

an = a1 * r^(n-1)

where:

an is the speed in the nth gear

a1 is the speed in the 1st gear

n is the gear number

r is the common ratio between successive terms.

First, we need to find the common ratio (r):

r = (a6 / a7)

Given that the speed in the 7th gear (a7) is 150 km/h and the speed in the 6th gear (a6) is 120 km/h for this example.

r = 120 / 150

r = 0.8

Now, we can find the speed in the 5th gear:

a5 = a1 * r^(5-1)

a5 = 30 * 0.8^4

a5 ≈ 73.828 km/h

So, the speed in the 5th gear is approximately 73.828 km/h.

Q.4

(a) Using the arithmetic sequence formula:

an = a1 + (n-1)d

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

d is the common difference between successive terms.

First, let's find the common difference (d):

d = (a6 - a1) / (6-1)

d = (140 - 25) / 5

d = 23

Now, let's find the speed in the 3rd gear (a3):

a3 = a1 + (3-1)d

a3 = 25 + 2x23

a3 = 71 km/h

So, the speed in the 3rd gear is 71 km/h.

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(b) The geometric sequence:

an = a1 x r^(n-1)

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

r is the common ratio between successive terms.

First, let's find the common ratio (r):

r = (a5/a6)

Given that the speed in the 6th gear (a6) is 140 km/h and the speed in the 5th gear (a5) is not given, let's say a5 = 110 km/h for this example.

r = a5/a6 = 110/140 = 0.7857

Now, let's find the speed in the 4th gear (a4):

a4 = a1 x r^(4-1)

a4 = 25 x (0.7857)^3

a4 ≈ 42.64 km/h

So, the speed in the 4th gear is approximately 42.64 km/h.

Q.5

(a) Using the arithmetic sequence formula:

an = a1 + (n-1)d,

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

d is the common difference between successive terms.

First, we need to find the common difference (d):

d = (a8 - a1)/(8 - 1)

d = (200 - 40)/(8 - 1)

d = 160/7

d ≈ 22.86

Now, let's find the speed in the 5th gear:

a5 = a1 + (5-1)d

a5 = 40 + 4d

a5 = 40 + 4(22.86)

a5 ≈ 131.43 km/h

(b) The geometric sequence:

an = a1 x r^(n-1),

where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

r is the common ratio between successive terms.

First, let's find the common ratio (r):

r = a7/a8

r = 170/200

r = 0.85

Now, let's find the speed in the 6th gear:

a6 = a1 x r^(6-1)

a6 = 40 x 0.85^5

a6 ≈ 76.42 km/h

So, the speed in the 5th gear is approximately 131.43 km/h and the speed in the 6th gear is approximately 76.42 km/h.

Q.6

(a) Using the arithmetic sequence formula:

$a_n = a_1 + (n-1)d$

where:

a_n is the speed in the nth gear,

a_1 is the speed in the 1st gear,

n is the term number (gear number), and

d is the common difference between successive terms.

First, we need to find the common difference:

$d = (a_9 - a_1)/(9 - 1)$

$d = (180 - 35)/8$

$d = 145/8$

Now, we can find the speed in the 6th gear:

$a_6 = a_1 + (6-1)d$

$a_6 = 35 + 5(145/8)$

$a_6 = 35 + 725/8$

$a_6 = 280/8 + 725/8$

$a_6 = 1005/8$

$a_6 \approx 125.63$ km/h

So, the speed in the 6th gear is approximately 125.63 km/h.

(b) The geometric sequence:

$a_n = a_1 \times r^{(n-1)}$

where:

a_n is the speed in the nth gear,

a_1 is the speed in the 1st gear,

n is the term number (gear number), and

r is the common ratio between successive terms.

First, we need to find the common ratio:

r = (a9/a8) = 180/155 (given)

r = 36/31

Now, we can find the speed in the 7th gear:

a7 = a1 × r^(7-1)

a7 = 35 × (36/31)^6

a7 ≈ 61.75 km/h

So, the speed in the 7th gear is approximately 61.75 km/h.

Q.7

(a) Using the arithmetic sequence formula:

an = a1 + (n-1)d

where:

an is the speed in the nth gear,

a1 is the speed in the 1st gear,

n is the gear number, and

d is the common difference between successive terms.

First, let's find the common difference (d):

d = (a6 - a1) / (6 - 1)

d = (45 - 15) / 5

d = 6

Now, let's find the speed in the 4th gear (a4):

a4 = a1 + (4-1)d

a4 = 15 + 3x6

a4 = 33 km/h

(b) The geometric sequence:

an = a1 x r^(n-1)

where:

an is the speed in the nth gear,

a1 is the speed in the 1st gear,

n is the gear number, and

r is the common ratio between successive terms.

First, let's find the common ratio (r):

r = a5 / a6

Given that a6 = 45 km/h and a5 = 36 km/h, we get:

r = 36 / 45

r = 0.8

Now, let's find the speed in the 5th gear (a5):

a5 = a1 x r^(5-1)

Given that a1 = 15, we get:

a5 = 15 x 0.8^4

a5 ≈ 36.56 km/h

So, the speed in the 4th gear is 33 km/h and the speed in the 5th gear is approximately 36.56 km/h.

Q.8

(a) Using the arithmetic sequence formula:

an = a1 + (n - 1)d

Where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

d is the common difference between successive terms.

First, find the common difference (d):

d = (a5 - a1)/(5 - 1)

d = (150 - 30)/(5 - 1)

d = 120/4

d = 30

Now, find the speed in the 3rd gear (a3):

a3 = a1 + (3 - 1)d

a3 = 30 + 2x30

a3 = 30 + 60

a3 = 90 km/h

So, the speed in the 3rd gear is 90 km/h.

(b) The geometric sequence:

an = a1 x r^(n-1)

Where:

an is the nth term (speed in the nth gear),

a1 is the first term (speed in the 1st gear),

n is the term number (gear number), and

r is the common ratio between successive terms.

First, find the common ratio (r):

r = a4/a5

r = 120/150

r = 0.8

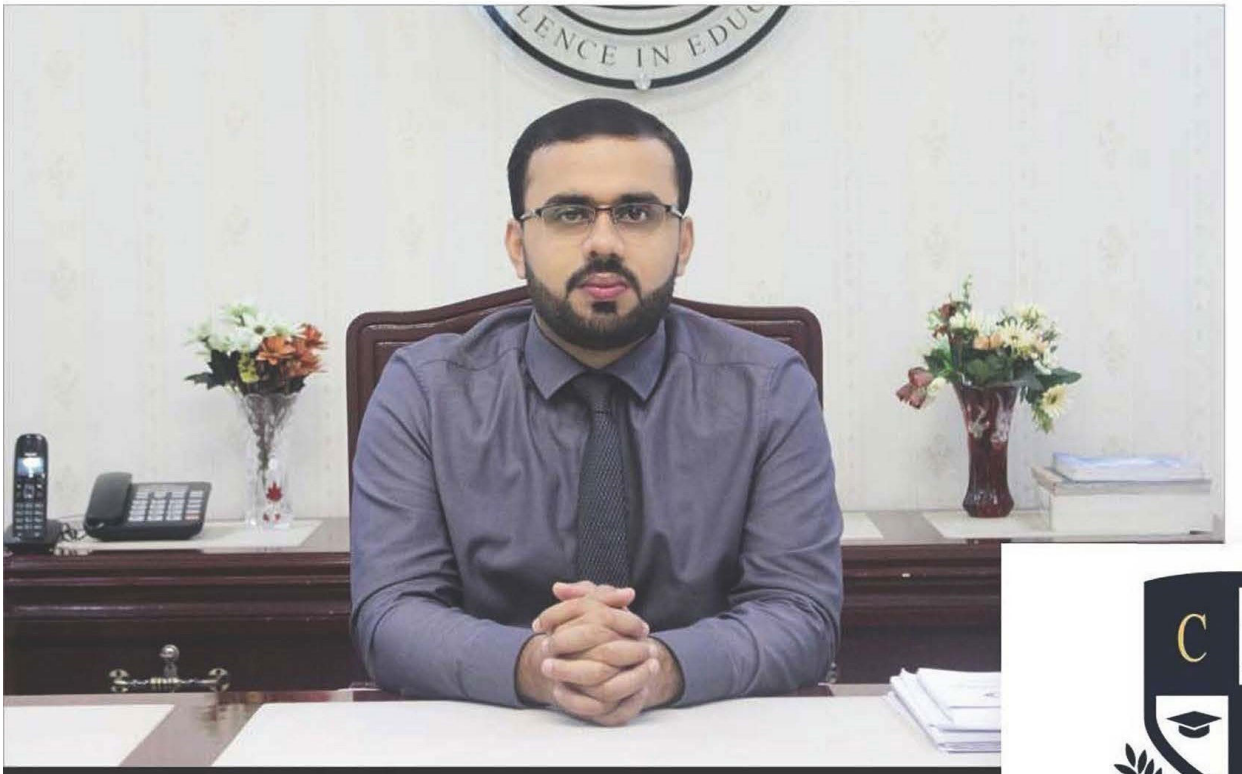
Now, find the speed in the 4th gear (a4):

a4 = a1 x r^(4-1)

a4 = 30 x (0.8)^3

a4 ≈ 58.59 km/h

So, the speed in the 4th gear is approximately 58.59 km/h.



DR. ASHAR RANA

CHEMISTRY ONLINE TUITION

Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

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CONTACT INFORMATION FOR **CHEMISTRY ONLINE TUITION**

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com

Address: 210-Old Brompton Road, London SW5 OBS, UK