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PURE MATH

ALGEBRA AND FUNCTION

Level & Board	EDEXCEL (A-LEVEL)
TOPIC:	ARITHMETIC SEQUENCE
PAPER TYPE:	SOLUTION - 4
TOTAL QUESTIONS	8
TOTAL MARKS	50

Q.1

(a) Using the arithmetic sequence formula:

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

Where:

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

a_1 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):

$$d = (a_5 - a_1)/(5 - 1)$$

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

$$d = 120/4$$

$$d = 30$$

Now, find the speed in the 3rd gear (a_3):

$$a_3 = a_1 + (3 - 1)d$$

$$a_3 = 30 + 2x30$$

$$a_3 = 30 + 60$$

$$a_3 = 90 \text{ km/h}$$

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

(b) The geometric sequence:

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

Where:

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

a_1 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.

Q.2

(a) To find the common difference (d) in an arithmetic sequence, we can use the formula for the nth term of the sequence:

an = a1 + (n - 1)d

In this case:

a1 = 3 (the first term)

a10 = 27 (the 10th term)

n = 10 (since we are given the 10th term)

We can use these values to find d:

27 = 3 + (10 - 1)d

Solving for d:

$27 = 3 + 9d$

$9d = 24$

$d = 24/9 = 8/3$

So, the common difference is 8/3.

(b) To find the sum of the first 15 terms (S15), we can use the formula for the sum of an arithmetic series:

$$Sn = n/2[2a1 + (n - 1)d]$$

In this case:

$n = 15$ (number of terms)

$a1 = 3$ (first term)

$d = 8/3$ (common difference)

Now, plug these values into the formula:

$$S15 = 15/2[2(3) + (15 - 1)(8/3)]$$

Calculate this expression to find S15.

Q.3

(a) To find the common difference (d), we can use the formula for the n-th term of an arithmetic sequence:

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

In this case:

a1 = 10 (the first term)

a15 = 34 (the 15th term)

n = 15 (since we are given the 15th term)

Now, we can use these values to find d:

34 = 10 + (15 - 1)d

Solving for d:

34 = 10 + 14d

14d = 24

d = 24/14 = 12/7

So, the common difference (d) is 12/7.

(b) To find the sum of the first 100 terms (S100), we can use the formula for the sum of an arithmetic series:

Sn = n/2[2a1 + (n - 1)d]

In this case:

n = 100 (number of terms)

a1 = 10 (first term)

d = 12/7 (common difference)

Now, plug these values into the formula:

S100 = 100/2[2(10) + (100 - 1)(12/7)]

Calculate this expression to find S100.

Q.4

(a) To find the common difference (d), we can use the formula for the n-th term of an arithmetic sequence:

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

In this case:

a1 = 7 (the first term)

a12 = 31 (the 12th term)

n = 12 (since we are given the 12th term)

Now, we can use these values to find d:

$$31 = 7 + (12 - 1)d$$

Solving for d:

$$d = 24/11$$

So, the common difference (d) is 24/11.

(b) To find the sum of the first 20 terms (S20), we can use the formula for the sum of an arithmetic series:

$$Sn = n/2[2a1 + (n - 1)d]$$

In this case:

n = 20 (number of terms)

a1 = 7 (first term)

d = 24/11 (common difference)

Now, plug these values into the formula:

$$S20 = 20/2[2(7) + (20 - 1)(24/11)]$$

Calculate this expression to find S20.

Q.5

(a) To find the common difference (d) of an arithmetic sequence, we can use the formula for the n-th term:

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

In this case, we know that:

a1 = 12 (the first term)

a8 = 38 (the eighth term)

n = 8 (since we are given the eighth term)

We can use these values to find d:

$$38 = 12 + 7d$$

Solving for d:

$$d = 26/7$$

So, the common difference is 26/7.

(b) To find the sum of the first 15 terms (S15) of the same arithmetic sequence, we can use the formula for the sum of an arithmetic series:

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$$Sn = n/2[2a1 + (n-1)d]$$

In this case, we know that:

n = 15 (number of terms)

a1 = 12 (first term)

d = 26/7 (common difference)

Now, we can plug these values into the formula:

S15 = 15/2[2(12) + (15-1)(26/7)]

Calculating this expression will give us the sum of the first 15 terms of the sequence.

Q.6

(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 term number (gear number), and

d is the common difference between successive terms.

First, we need to find the common difference:

d = (a9 - a1)/(9 - 1)

d = (180 - 35)/8

d = 145/8

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

a6 = a1 + (6-1)d

a6 = 35 + 5(145/8)

a6 = 35 + 725/8

a6 = 280/8 + 725/8

a6 = 1005/8

a6 ≈ 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:

$r = (a_9/a_8) = 180/155$ (given)

$r = 36/31$

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

$a_7 = a_1 \times r^{(7-1)}$

$a_7 = 35 \times (36/31)^6$

$a_7 \approx 61.75$ km/h

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

Q.7

(a) Using the arithmetic sequence formula:

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

where:

a_n is the speed in the nth gear,

a_1 is the speed in the 1st gear,

n is the 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) To find the common difference (d) in an arithmetic series, we can use the formula for the nth term of an arithmetic sequence:

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

Where:

an is the nth term

a1 is the first term

n is the number of terms

d is the common difference

In your case:

a1 = 16 (the first term)

a21 = 24 (the 21st term)

n = 21 (since we are given the 21st term)

Now, we can use these values to find d:

$$24 = 16 + (21-1)d$$

Solving for d:

$$24 = 16 + 20d$$

$$20d = 8$$

$d = 8/20 = 2/5$

So, the common difference (d) is 2/5.

(b) Now, to find the sum of the first 500 terms (S500), we can use the formula for the sum of an arithmetic series:

$$S_n = n/2[2a_1 + (n-1)d]$$

Where:

S_n is the sum of the first n terms

n is the number of terms

a_1 is the first term

d is the common difference

In this case:

n = 500 (number of terms)

a_1 = 16 (first term)

d = 2/5 (common difference)

Now, plug these values into the formula:

$$S_{500} = 500/2[2(16) + (500-1)(2/5)]$$

Calculate this expression to find S500.

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