Write your name here

Surname	Other Names

Mathematics

2018 Practice Paper
Paper 1 (Non-Calculator)
Higher Tier

Time: 1 hour 30 minutes

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – there may be more space than you need.
- **Calculators may not be used.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**

Information

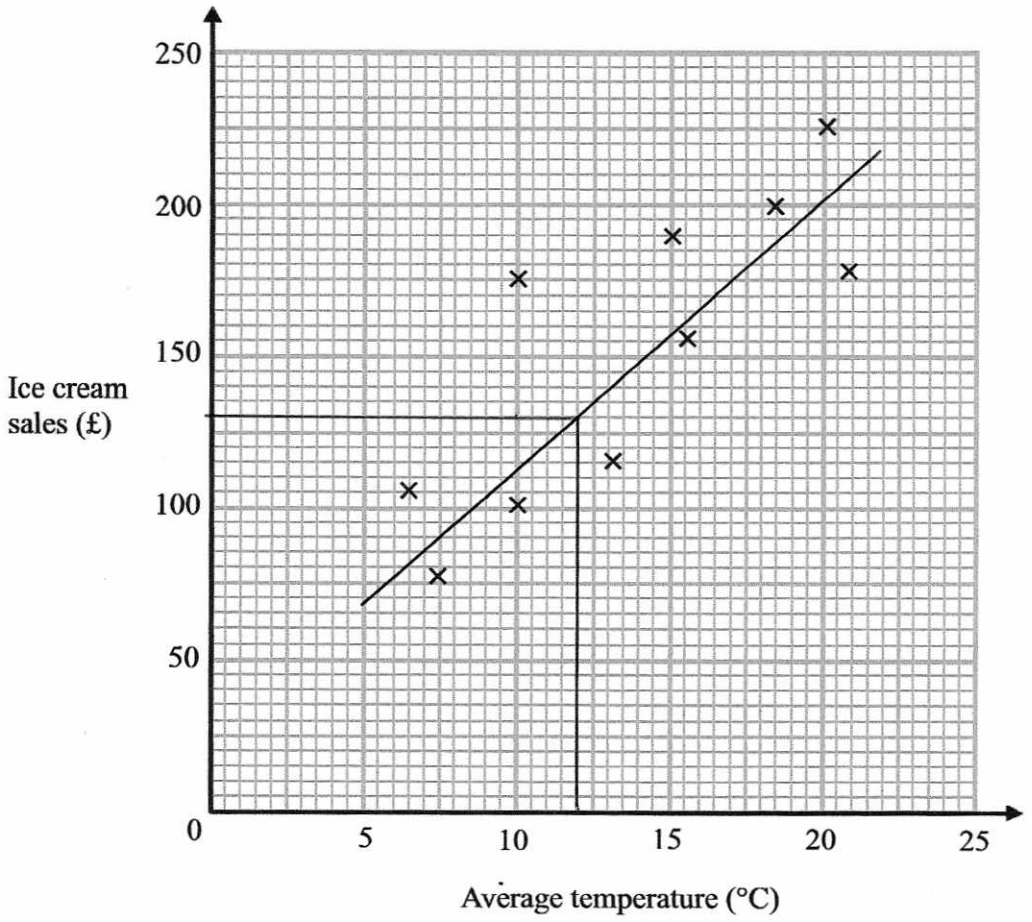
- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

1 The average daytime temperature for 10 days is recorded.
A shop also records its ice cream sales for each of the 10 days.

The scatter graph shows this information.



(a) What type of correlation does the scatter graph show?

positive

(1)

(b) On the 11th day the temperature was 12°.
Estimate the ice cream sales on the 11th day.

£130

£125 – £145 (2)

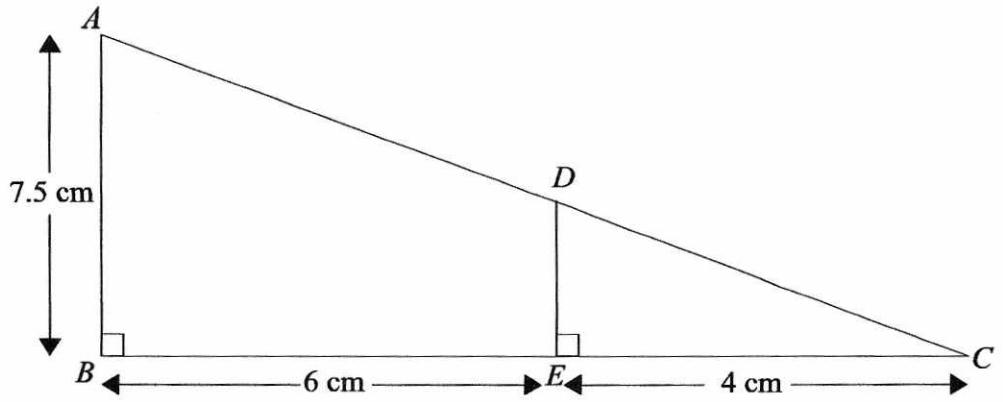
(c) The shop's manager wants to use the scatter graph to predict the ice cream sales for a day with an average temperature of 2°C. Comment on the reliability of this prediction.

It is not reliable 2°C is not within the range of data we have.

(1)

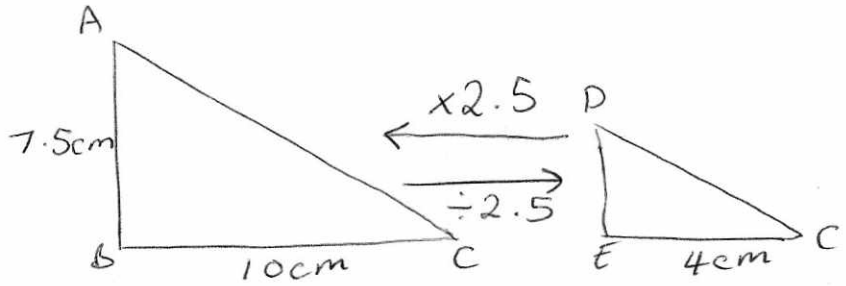
(Total for question 1 is 5 marks)

2



Scale factor $= \frac{10}{4} = 2.5$

(a) Find the length of *DE*

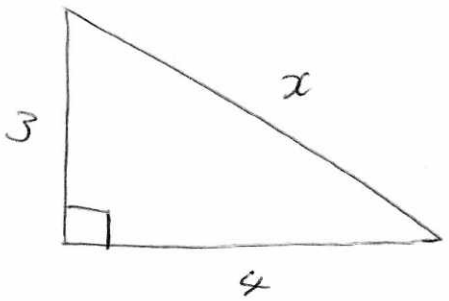


$7.5 \div 2.5$

.....3.....cm

(1)

(b) Find the length of *DC*



$3^2 + 4^2 = x^2$

$9 + 16 = x^2$

$25 = x^2$

$x = 5$

.....5.....cm

(2)

(Total for question 2 is 3 marks)

3 Stevie has some marbles. x
Freddie has twice as many marbles are Stevie. $2x$
Danny has 5 more marbles than Freddie.

In total they have 55 marbles. $2x + 5$

How many marbles does Danny have?

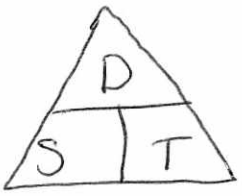
$$x + 2x + 2x + 5 = 55$$
$$5x + 5 = 55$$
$$5x = 50$$
$$x = 10$$

Danny has: $2(10) + 5 = \underline{25}$

25

(Total for question 3 is 3 marks)

4 Rachel drives 300 miles from London to Newcastle.
She drives the first 165 miles at an average speed of 60 mph.
From this point it takes Rachel 3 hours and 15 minutes to complete her journey.



What was Rachel's average speed for the whole journey?

$$\text{Av speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

First part of journey: $\text{time} = \frac{\text{distance}}{\text{speed}}$

$$= \frac{165}{60} = \frac{33}{12} = \frac{11}{4}$$

$2\frac{3}{4}$ hours

Total time = 3hr 15 + 2 hr 45
= 6 hours

$$\text{Av speed} = \frac{300}{6} = 50$$

50 mph

(Total for question 4 is 4 marks)

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5 In a sale, normal prices are reduced by 25%.
Freddie bought a car in the sale.
The sale price of the car was £7500.
Work out the normal price of the car.

£7500 = 75%

£2500 = 25%

£10000 = 100%

£ 10 000

(Total for question 5 is 2 marks)

6 The distance from Earth to Mars is approximately 7.834×10^{10} m.
The distance from Earth to Neptune is approximately 4.3514×10^{12} m.

(a) Estimate how many times further away Neptune is from Earth than Mars is from Earth.

$\frac{8 \times 10^{10}}{4 \times 10}$ $\frac{4 \times 10^{12}}{8 \times 10^{10}} = 0.5 \times 10^{2}$

$= 50$

50

(3)

(b) Is your answer to part (a) an underestimate or an overestimate?
Give a reason for your answer.

underestimate. I rounded the numerator down and the denominator up → the actual answer would be bigger.

(1)

(Total for question 6 is 4 marks)

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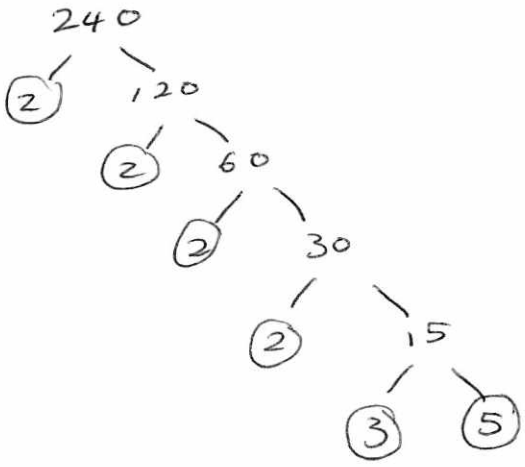
7 Write 240 as a product of its prime factors.



$2^4 \times 3 \times 5$ or $2 \times 2 \times 2 \times 2 \times 3 \times 5$

$2 \times 2 \times 2 \times 2 \times 3 \times 5$

(Total for question 7 is 3 marks)

8 Two maths classes, class A and class B, took a test.

The mean score of the 18 students in class A was 50%.
The mean score of the 22 students in class B was 70%.

What was the mean score of all 40 students?

Total score class A = 18 × 50

= 900

Total score class B = 22 × 70

20 × 70 = 1400

2 × 70 = 140

22 × 70 = 1540

Total score (all) = 900 + 1540

= 2440

Mean = $\frac{2440}{40} = \frac{244}{4} = \frac{122}{2} = 61$

61 .....%

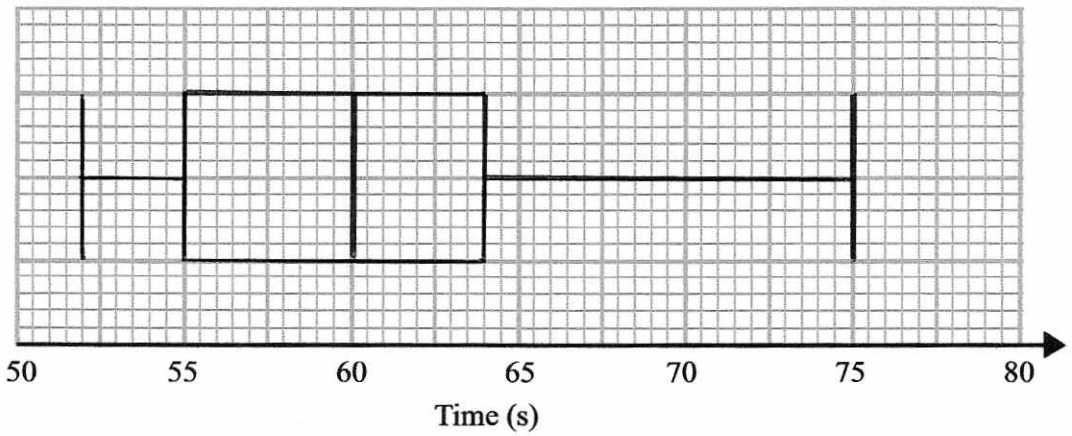
(Total for question 8 is 3 marks)

9 The times of 15 students running a race are recorded below.

52 54 54 55 58 58 59 60 60 61 61 64 67 70 75

Draw a box plot for this information.

Median = 60 L.Q. = 55 u.Q = 64



(Total for question 9 is 2 marks)

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10 In a cinema the ratio of adults to children is 3:1 $\frac{1}{4}$ children
The ratio of boys to girls is 3:2 $\frac{2}{5}$ girls

What fraction of all the people in the cinema are girls?

$\frac{1}{4} \times \frac{2}{5} = \frac{2}{20} = \frac{1}{10}$

$\frac{1}{10}$

(Total for question 10 is 3 marks)

11 Expand and Simplify $(x + 5)(x - 3)(2x - 1)$

$(x^2 - 3x + 5x - 15)(2x - 1)$

$(x^2 + 2x - 15)(2x - 1)$

$2x^3 - x^2 + 4x^2 - 2x - 30x + 15$

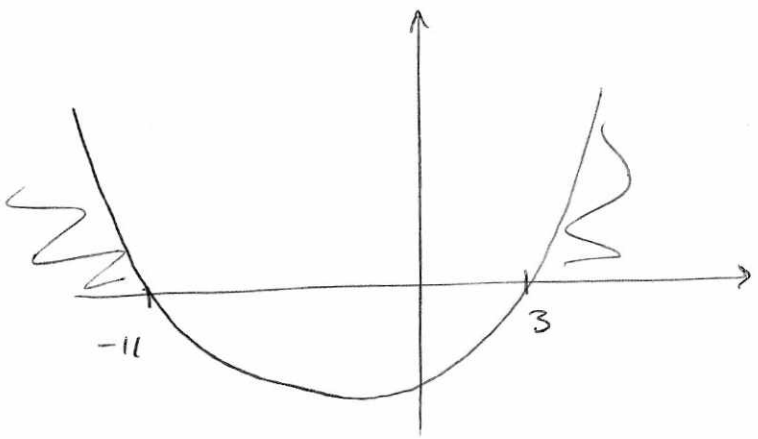
$2x^3 + 3x^2 - 32x + 15$

(Total for question 11 is 3 marks)

12 Solve the inequality $x^2 + 8x - 33 > 0$

$(x + 11)(x - 3) > 0$

$x = -11 \quad x = 3$



$x < -11$ or $x > 3$

(Total for question 12 is 4 marks)

13 Prove algebraically that the recurring decimal $0.68\dot{1}\dot{1}$ can be written as $\frac{15}{22}$

$0.68\dot{1}\dot{1} = x$

$6.8\dot{1}\dot{1} = 10x$

$681.8\dot{1}\dot{1} = 1000x$

$675 = 990x$

$x = \frac{675}{990} = \frac{67.5}{99} = \frac{135}{198} = \frac{45}{66} = \frac{15}{22}$

(Total for question 13 is 2 marks)

14 Make x the subject of the formula $2x + a = b(x - 2)$

$2x + a = bx - 2b$

$2x - bx = -2b - a$

$x(2 - b) = -2b - a$

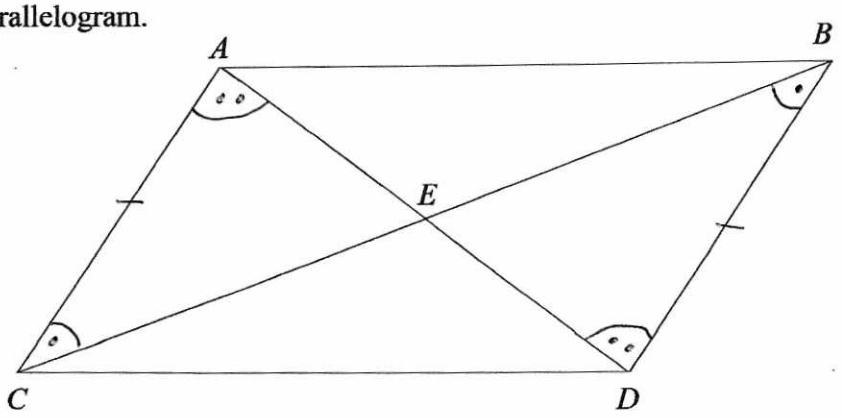
$x = \frac{-2b - a}{2 - b}$

OR $x = \frac{2b + a}{b - 2}$

$x = \frac{-2b - a}{2 - b}$

(Total for question 14 is 3 marks)

15 *ABCD* is a parallelogram.



E is the point where the diagonals *AD* and *BC* meet.
Prove that triangle *ACE* and triangle *BDE* are congruent.

AC = BD opposite sides in a parallelogram

ACE = EBD alternate angles are equal

CAE = EDB alternate angles are equal

ACE and BDE are congruent ASA

(Total for question 15 is 4 marks)

16 Prove that the sum of the squares of two consecutive odd numbers is always 2 more than a multiple of 8

$$(2n+1)^2 + (2n+3)^2$$

$$(2n+1)(2n+1) + (2n+3)(2n+3)$$

$$4n^2 + 2n + 2n + 1 + 4n^2 + 6n + 6n + 9$$

$$8n^2 + 16n + 10$$

$$8n^2 + 16n + 8 + 2$$

$$\underbrace{8(n^2 + 2n + 1)}_{\text{Multiple of 8}} \underbrace{+ 2}_{+2}$$

(Total for question 16 is 2 marks)

17 Find the value of $\left(\frac{64}{125}\right)^{-\frac{2}{3}}$

$$= \left(\frac{4}{5}\right)^{-2} = \left(\frac{5}{4}\right)^2 = \frac{25}{16}$$

$\frac{25}{16}$

(Total for question 17 is 2 marks)

18 c is inversely proportional to d

When $c = 15$, $d = 4$

Find the value of c when $d = 12$

$$c = \frac{k}{d}$$

$$15 = \frac{k}{4}$$

$$60 = k$$

$$c = \frac{60}{d}$$

$$c = \frac{60}{12}$$

$$= 5$$

$c =$ 5

(Total for question 18 is 3 marks)

19 Simplify fully $\dfrac{(4+2\sqrt{3})(4-2\sqrt{3})}{\sqrt{11}}$

$2\sqrt{3} \times 2\sqrt{3} = 4\sqrt{9} = 4 \times 3 = 12$

You must show all your working.

$$\frac{16 - 8\sqrt{3} + 8\sqrt{3} - 12}{\sqrt{11}}$$

$$\frac{4 \times \sqrt{11}}{\sqrt{11} \times \sqrt{11}} = \frac{4\sqrt{11}}{11}$$

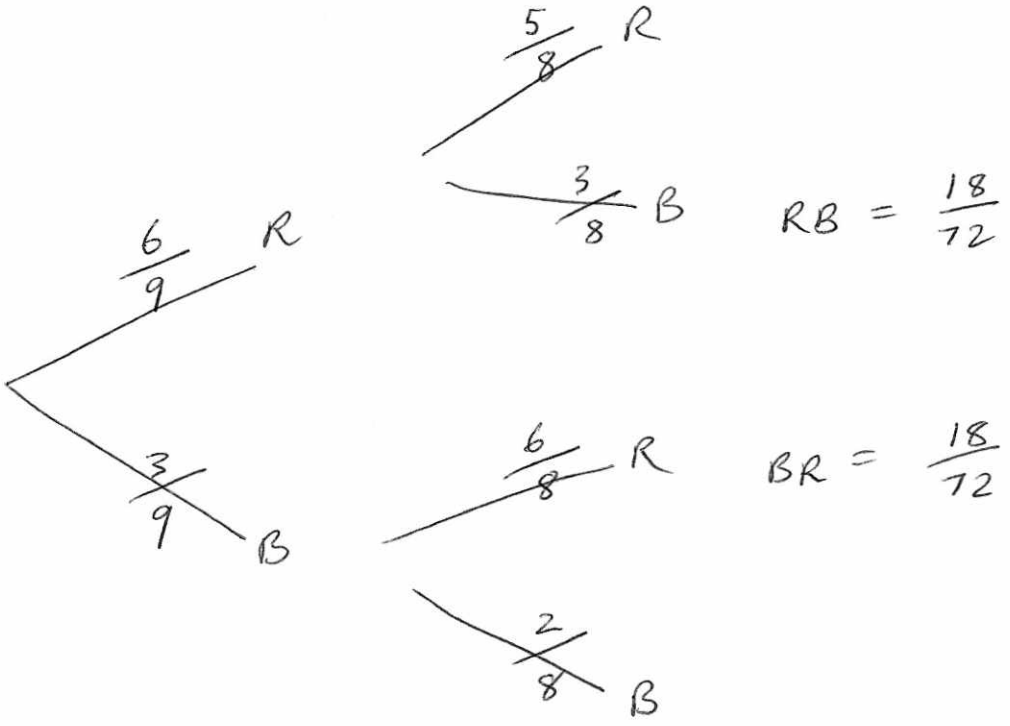
(Total for question 19 is 3 marks)

20 There are 6 red counters and 3 blue counters in a bag.

Joe takes at random a counter from the bag and does not replace it.

He then takes at random a second counter from the bag.

Calculate the probability that Joe has one counter of each colour.



$\frac{18}{72} + \frac{18}{72} = \frac{36}{72}$ OR $\frac{1}{2}$

$\frac{1}{2}$

(Total for question 20 is 3 marks)

21 Solve the simultaneous equations

$$x^2 + y^2 = 26$$
$$2x - y = 3$$

$2x = 3 + y$

$y = 2x - 3$

$x^2 + (2x-3)^2 = 26$

$x^2 + (2x-3)(2x-3) = 26$

$x^2 + 4x^2 - 6x - 6x + 9 = 26$

$5x^2 - 12x + 9 = 26$

$5x^2 - 12x - 17 = 0$

$\frac{(5x+5)(5x-17)}{5} = 0$

$5 \times 17 = 85$

1 85

5 17

$(x+1)(5x-17) = 0$

$x = -1 \quad x = \frac{17}{5}$

$y = 2(-1) - 3$

$= -5$

$y = 2\left(\frac{17}{5}\right) - 3$

$= \frac{34}{5} - 3$

$= \frac{34}{5} - \frac{15}{5}$

$= \frac{19}{5}$

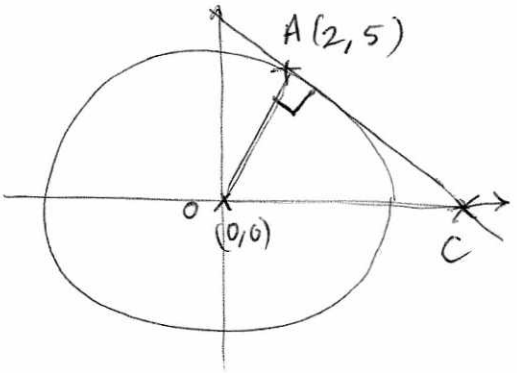
$x = -1$ or $\frac{17}{5}$

$y = -5$ or $\frac{19}{5}$

(Total for question 21 is 5 marks)

22 The line l is a tangent to the circle $x^2 + y^2 = 29$ at the point A.
A is the point (2, 5).

The line l crosses the x axis at the point C.
Work out the area of triangle OAC.



gradient of OA

$= \frac{5-0}{2-0} = \frac{5}{2}$

AC is perpendicular to OA $\therefore$ $m = -\frac{2}{5}$

$y = -\frac{2}{5}x + c$ $\quad (2, 5)$ $\quad x \; y$

$5 = -\frac{2}{5}(2) + c$

$5 = -\frac{4}{5} + c$

$\frac{25}{5} = -\frac{4}{5} + c$

$c = \frac{29}{5}$

$y = -\frac{2}{5}x + \frac{29}{5}$

Crosses x axis when $y = 0$

$0 = -\frac{2}{5}x + \frac{29}{5}$

$\frac{2}{5}x = \frac{29}{5}$

$2x = 29$

$x = 14.5$

Base 14.5
Height 5

Area of triangle $= \frac{1}{2}$ base $\times$ height

$= \frac{1}{2} \times 14.5 \times 5$

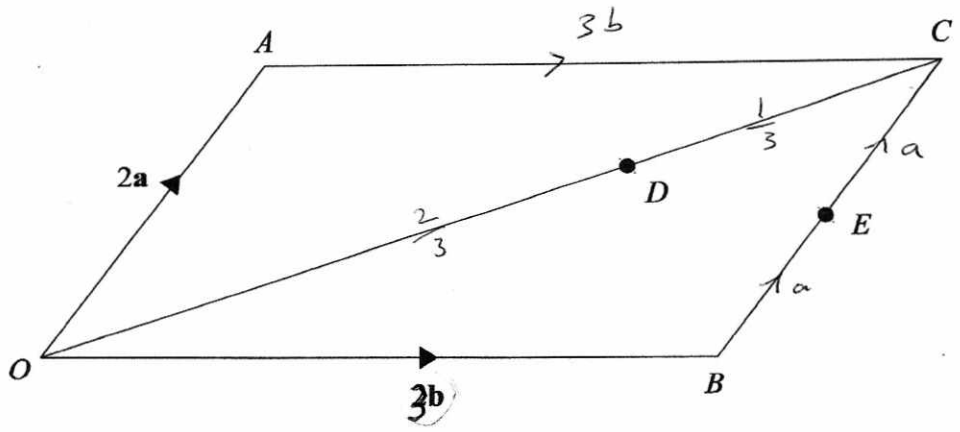
$= \frac{1}{2} \times 72.5$

~~$= 26.25$~~ $= 36.25$

36.25
~~26.25~~ (units^2)

(Total for question 22 is 5 marks)

23



$\overrightarrow{OA} = 2a$

$\overrightarrow{OB} = 3b$

D is the point on OC such that OD:DC = 2:1

E is the midpoint of BC

Show that A, D and E are on the same straight line.

$\overrightarrow{OC} = 2a + 3b$

$\overrightarrow{OD} = \frac{2}{3}(2a + 3b)$

$= \frac{4}{3}a + 2b$

$\overrightarrow{AD} = -2a + \frac{4}{3}a + 2b$

$= -\frac{2}{3}a + 2b$

$\overrightarrow{AE} = 3b - a$

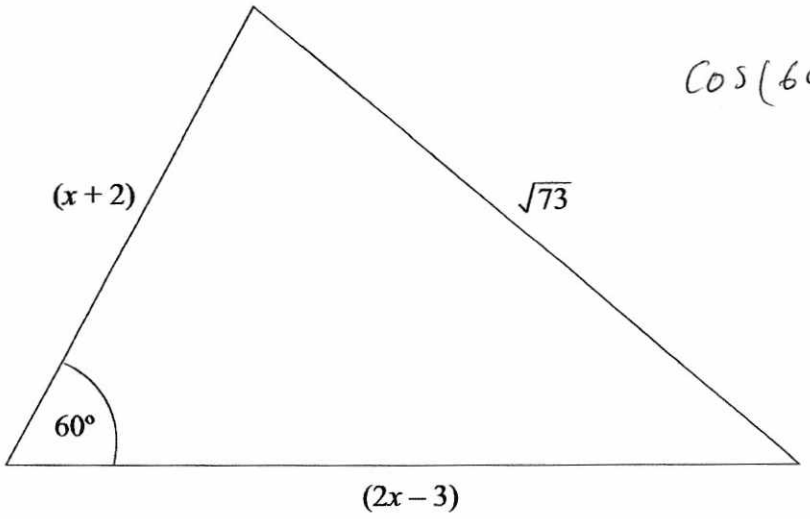
$\overrightarrow{AD} = \frac{2}{3}(3b - a)$

A, B and E are on the same straight line.

$\overrightarrow{AE}$ and $\overrightarrow{AD}$ are parallel and pass through the same points.

(Total for question 23 is 4 marks)

24



$\cos(60) = \frac{1}{2}$

Work out the value of x.

$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$73 = (x+2)^2 + (2x-3)^2 - 2(x+2)(2x-3)\cos(60)$$

$$73 = (x+2)(x+2) + (2x-3)(2x-3) - 2(x+2)(2x-3)\left(\tfrac{1}{2}\right)$$

$$73 = x^2 + 2x + 2x + 4 + 4x^2 - 6x - 6x + 9 - (2x^2 - 3x + 4x - 6)$$

$$73 = 5x^2 - 8x + 13 - (2x^2 + x - 6)$$

$$73 = 5x^2 - 8x + 13 - 2x^2 - x + 6$$

$$73 = 3x^2 - 9x + 19$$

$$0 = 3x^2 - 9x - 54$$

$$0 = x^2 - 3x - 18$$

$$0 = (x - 6)(x + 3)$$

$x = 6$ $\quad$ $x = -3$

$\times$ cannot have a negative length.

$x = 6$

(Total for question 24 is 5 marks)