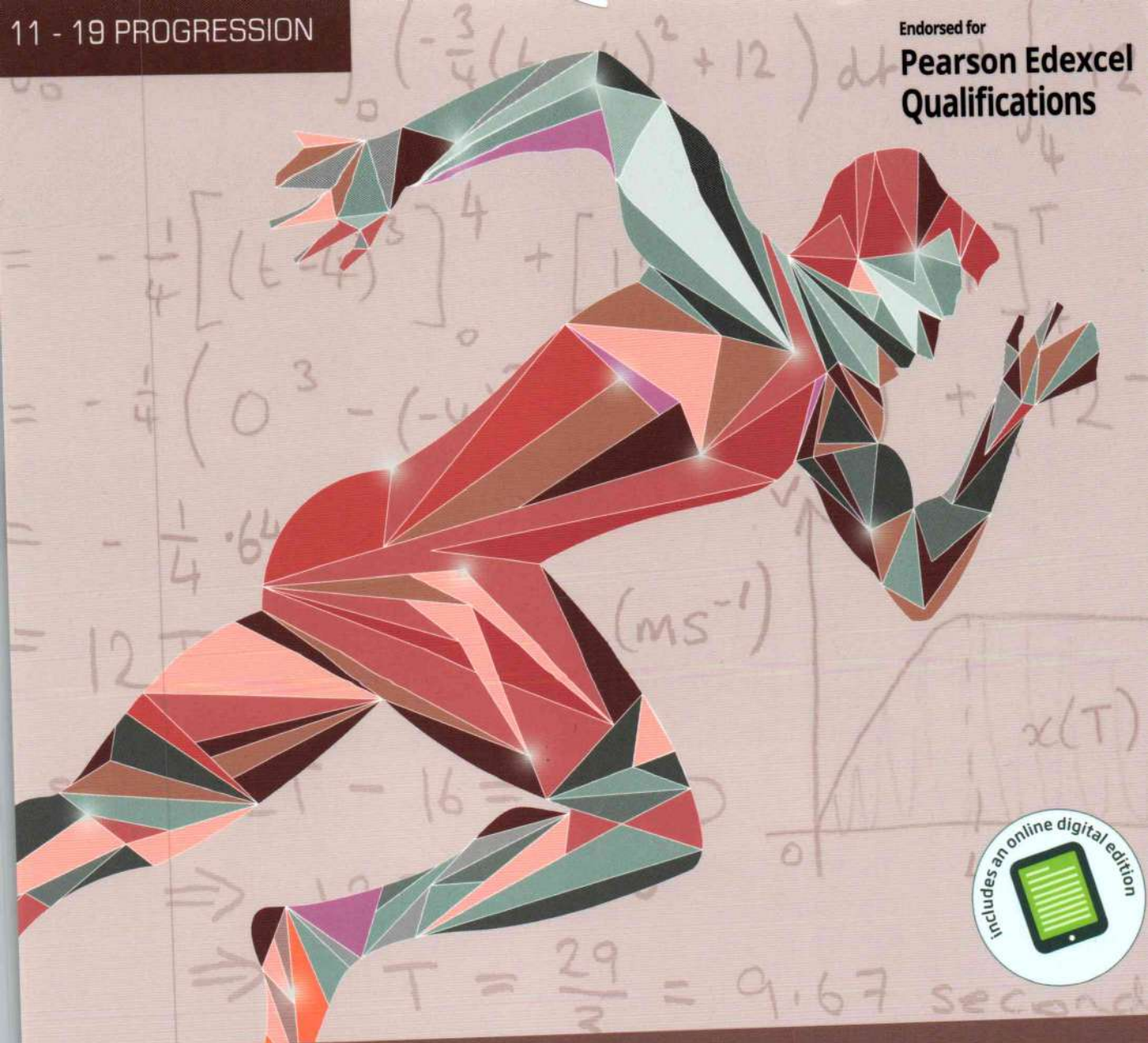


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Pearson Edexcel A level Mathematics

Statistics and Mechanics

Year 2

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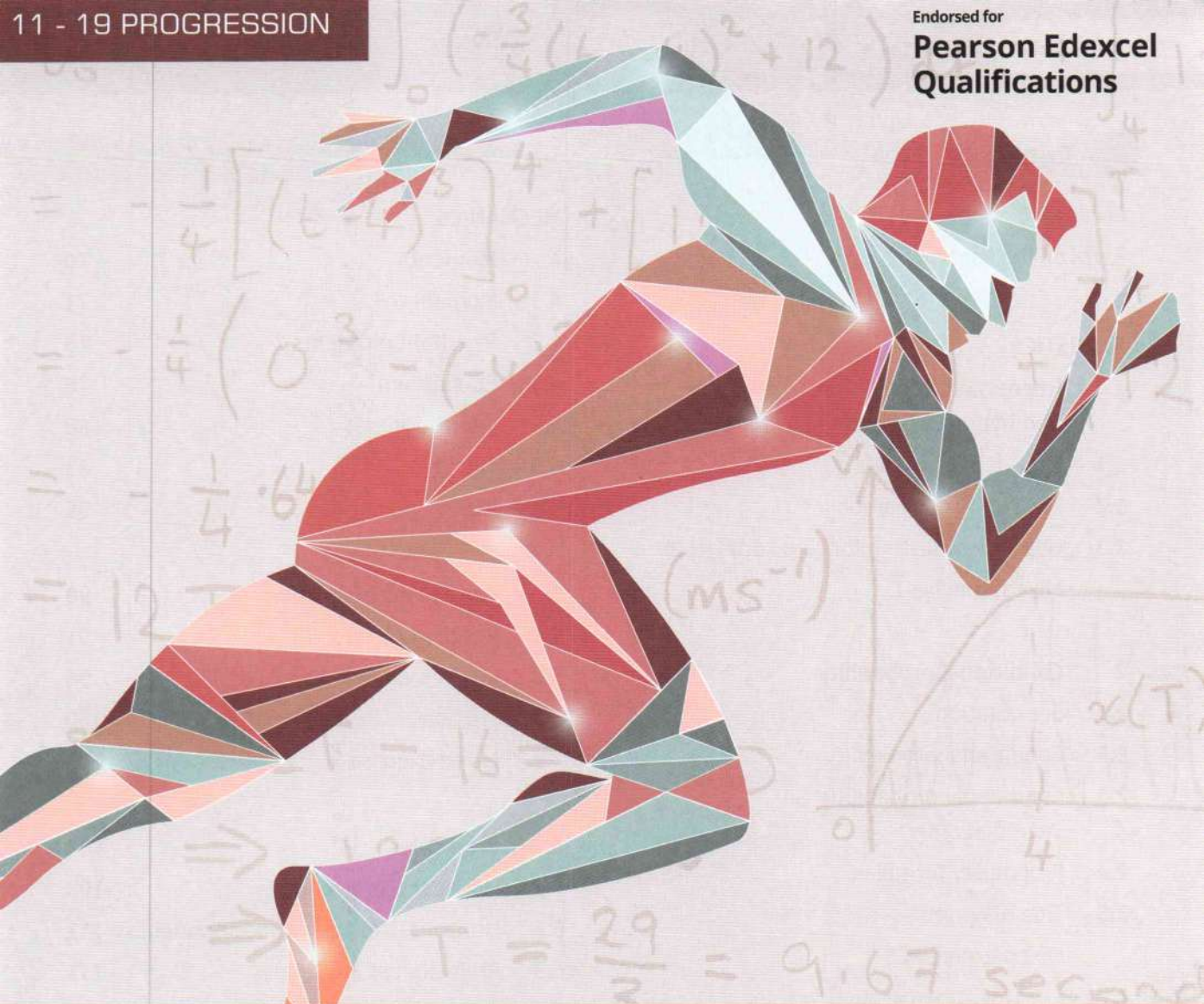
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Pearson Edexcel A level Mathematics

Statistics and Mechanics Year 2

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Overarching themes

The following three overarching themes have been fully integrated throughout the Pearson Edexcel AS and A level Mathematics series, so they can be applied alongside your learning and practice.

1. Mathematical argument, language and proof

- Rigorous and consistent approach throughout
- Notation boxes explain key mathematical language and symbols
- Dedicated sections on mathematical proof explain key principles and strategies
- Opportunities to critique arguments and justify methods

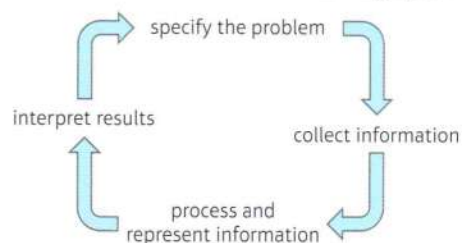
2. Mathematical problem solving

- Hundreds of problem-solving questions, fully integrated into the main exercises
- Problem-solving boxes provide tips and strategies
- Structured and unstructured questions to build confidence
- Challenge boxes provide extra stretch

3. Mathematical modelling

- Dedicated modelling sections in relevant topics provide plenty of practice where you need it
- Examples and exercises include qualitative questions that allow you to interpret answers in the context of the model
- Dedicated chapter in Statistics & Mechanics Year 1/AS explains the principles of modelling in mechanics

The Mathematical Problem-solving cycle



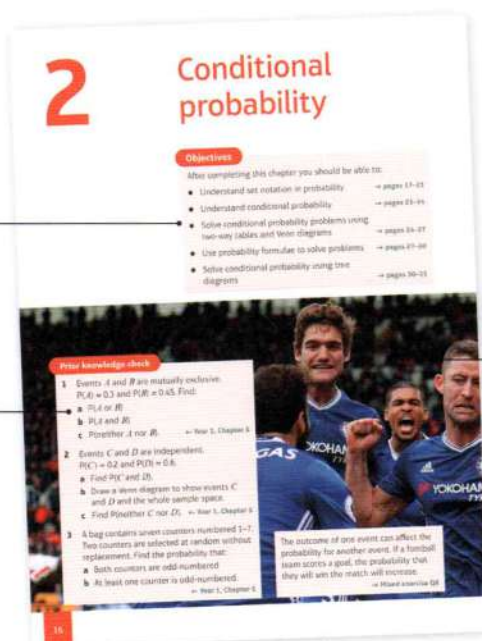
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Each chapter starts with a list of objectives

The *Prior knowledge check* helps make sure you are ready to start the chapter



The real world applications of the maths you are about to learn are highlighted at the start of the chapter with links to relevant questions in the chapter

Exercise questions are carefully graded so they increase in difficulty and gradually bring you up to exam standard

Exercises are packed with exam-style questions to ensure you are ready for the exams

Problem-solving boxes provide hints, tips and strategies, and Watch out boxes highlight areas where students often lose marks in their exams

Exam-style questions are flagged with **(E)**

Problem-solving questions are flagged with **(P)**

Each chapter ends with a Mixed exercise and a Summary of key points

Challenge boxes give you a chance to tackle some more difficult questions

Each section begins with explanation and key learning points

Step-by-step worked examples focus on the key types of questions you'll need to tackle

Every few chapters a Review exercise helps you consolidate your learning with lots of exam-style questions

Chapter 2

Conditional probability

5. A and B are events. $P(A) = 0.5$, $P(B) = 0.2$ and $P(A \cap B) = 0.1$. Find:
 a. $P(A \cup B)$ b. $P(B|A)$
 c. $P(A|B)$ d. $P(A \cap B)$ **Hint** Draw a Venn diagram.

6. C and D are two events. $P(C) = 0.3$, $P(C \cap D) = 0.15$ and $P(C \cup D) = 0.5$. Find:
 a. $P(C \cap D)$ b. $P(C \cap D)$ c. $P(C)$ d. $P(C \cap D)$

7. The probability that a member of a sports club plays hockey (H) is 0.5 and the probability that they play cricket (C) is 0.4. The probability that they play both is 0.25.
 a. Draw a Venn diagram to illustrate these probabilities.
 b. Find:
 i. $P(H \cup C)$ ii. $P(H \cap C)$ iii. $P(H \cap C)$

8. A bag contains 50 counters numbered from 1 to 50. The counters are either red or blue. A counter is picked at random. The two events R and E are the events 'counter is red' and 'counter is even-numbered' respectively. Given that $n(R) = 17$, $n(E) = 30$ and $n(R \cap E) = 40$,
 a. Draw a Venn diagram to illustrate the outcomes.
 b. Find:
 i. $n(R \cap E)$ ii. $P(R \cap E)$ iii. $P(R \cap E)$ **Watch out** $n(R \cap E)$ represents the number of outcomes in the event $R \cap E$, whereas $P(R \cap E)$ represents the probability that the event $R \cap E$ occurs.

9. A , B and C are three events with $P(A) = 0.55$, $P(B) = 0.35$ and $P(C) = 0.4$. $P(A \cap C) = 0.2$. Given that A and B are mutually exclusive and B and C are independent,
 a. Draw a Venn diagram to illustrate the probabilities.
 b. Find:
 i. $P(A \cap B)$ ii. $P(A \cap B \cap C)$ iii. $P(A \cap B \cap C)$ **Problem-solving** D is the empty set. $P(D) = 0$.

10. A , B and C are three events with $P(A) = 0.25$, $P(B) = 0.4$, $P(A \cap B) = 0.15$, $P(A \cap C) = 0.1$, $P(B \cap C) = 0.1$ and $P(A \cap B \cap C) = 0.05$. Given that A and B are independent, B and C are independent, and A and C are independent,
 a. Draw a Venn diagram to illustrate the probabilities.
 b. Find:
 i. $P(A \cap B \cap C)$ ii. $P(A \cap B \cap C)$ iii. $P(A \cap B \cap C)$ **Problem-solving** D is the empty set. $P(D) = 0$.

11. Members of a school book club read either murder mysteries (M), ghost stories (G) or epic fiction (E). $P(M) = 0.5$, $P(G) = 0.4$ and $P(E) = 0.6$. Given that no-one reads both ghost stories and epic fiction and that $P(M \cap G) = 0.3$,
 a. Draw a Venn diagram to illustrate these probabilities.
 b. Find:
 i. $P(M \cap G)$ ii. $P(M \cap G \cap E)$ iii. $P(M \cap G \cap E)$ **Challenge** Given that events A , B and C are all independent and that $P(A) = 0.5$, $P(B) = 0.4$ and $P(C) = 0.3$, find, in terms of x , y and z ,
 a. $P(A \cap B \cap C)$ b. $P(A \cap B \cap C)$ c. $P(A \cap B \cap C)$

2.2 Conditional probability

The probability of an event can change depending on the outcome of a previous event. For example, the probability of your being late for work may change depending on whether you oversleep or not. Situations like this can be modelled using **conditional probability**. You use a vertical line to indicate conditional probabilities.

• The probability that B occurs given that A has already occurred is written as $P(B|A)$. Similarly, $P(A|B)$ describes the probability of A occurring given that B has not occurred.

• For independent events, $P(A|B) = P(A|B)$, $P(B|A) = P(B|A)$, and $P(A \cap B) = P(A)P(B)$. You can use this condition to determine independence.

You can solve some problems involving conditional probability by considering a restricted sample space of the outcomes where one event has already occurred.

Example 3

A school has 75 students in year 12. Of these students, 25 study only humanities subjects (H) and 37 study only science subjects (S). 11 students study both science and humanities subjects.

a. Draw a two-way table to show this information.
 b. Find:
 i. $P(S|H)$ ii. $P(S|H)$ iii. $P(S|H)$

2 Review exercise

1. A uniform plank AB of length 5 m and weight 200 N, rests in a horizontal position on supports at C and D , where $AC = 0.5$ m and $BD = 0.5$ m. A builder of weight 100 N stands on the plank at M where $AM = 2$ m, as shown in the diagram. The plank is modelled as a particle, and the builder is modelled as a rod. Calculate:
 a. the magnitude of the reaction at C (3)
 b. the magnitude of the reaction at D (3)
 c. State how you have used the modelling assumption that the builder is a particle. (1)
2. A uniform plank AC of length 5 m and mass 40 kg, rests in a horizontal position on supports at B and C , where $AB = 1$ m and $BC = 4$ m. The plank is modelled as a rod. Show that:
 a. the magnitude of the reaction at B is 100 N (3)
 b. the magnitude of the reaction at C is 100 N (3)
 c. State how you have used the modelling assumption that the plank is:
 i. uniform (1)
 ii. a rod. (1)
3. A lever consists of a uniform steel rod AB of weight 200 N and length 3 m, which rests on a pivot at C . A 200 N weight is placed at B , and is supported by a force of 200 N applied vertically downwards at A . Given that the lever is in equilibrium, calculate the length AC . (3)
4. A particle of mass 1 kg is moving up a rough slope that is inclined at an angle α to the horizontal where $\tan \alpha = \frac{3}{4}$. A force of magnitude 10 N acts horizontally on the particle towards the plane. Given that the coefficient of friction between the particle and the slope is 0.2 and that the particle is moving at a constant velocity, calculate the value of P . (3)

Exam-style practice

Mathematics

A Level

Paper 3: Statistics and Mechanics

Time: 2 hours

You must have: Mathematical Formulae and Statistical Tables, Calculator

SECTION A: STATISTICS

1. An electrical engineer makes components for computer systems. She claims that the components last longer than 500 hours on 32% of occasions. In a random sample of 40 of the components, 3 last longer than 500 hours.
 a. Find $P(X = 3)$. (1)
 b. Write down two conditions under which the normal approximation may be used as an approximation to the binomial distribution. (2)
 c. Assuming the engineer's claim to be correct, use a normal approximation to find the probability that 12 or fewer components last longer than 500 hours. (3)
 d. Using your answer to part c, comment on the engineer's claim. (1)
2. $P(A) = 0.4$, $P(B) = 0.55$ and $P(C) = 0.28$. Given that $P(A \cap B) = 0.2$, that events A and C are mutually exclusive and that events B and C are statistically independent,
 a. Draw a Venn diagram to illustrate events A , B and C . (5)
 b. Show that events A and B are not statistically independent. (2)
 c. Find $P(B|A)$. (2)
 d. Find $P(C|A \cap B)$. (2)
3. The daily mean air temperature, $^{\circ}\text{C}$, is recorded in Perth for the month of October.
- | T | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| f | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
- a. State, with reason, whether T is a discrete or continuous variable. (1)
 b. Use your calculator to find estimates for the mean and standard deviation of the temperatures. (2)
 c. Give two reasons why a histogram could be used to display this data. (2)
 d. Use linear interpolation to find the 10th to 90th interpercentile range. (3)

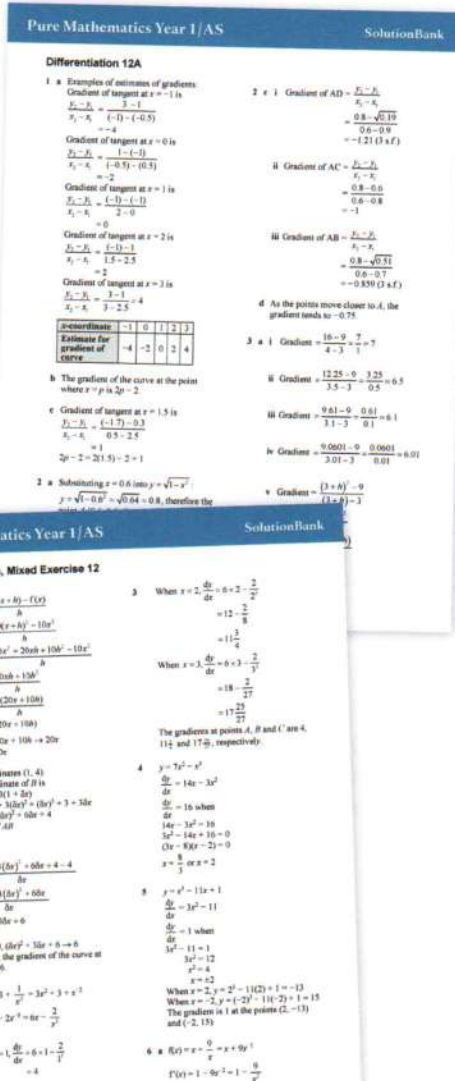
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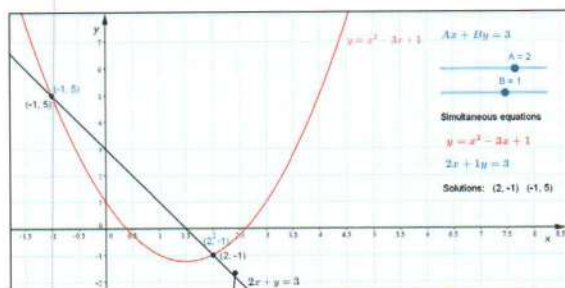
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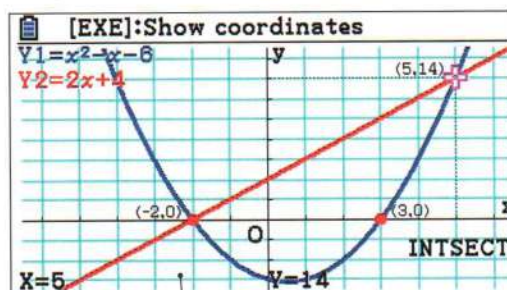
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