AS-Level Mathematics

Edexcel

2024 Predicted Paper

Paper 2

Mechanics and Statistics

Primrose Kitten
YouTube tutorials for GCSE and A-Level

Scan me for walkthrough

Name:.....

Date:.....

1 hour 15 minutes allowed

You may use a calculator

Rough Grade Boundaries

These do not guarantee you the same mark in the exam.

A - 65%
B - 55%
C - 45%
D - 40%
E - 30%

Question	Possible Marks	Marks Gained
Section A: Mechanics	30	
Section B: Statistics	30	
Total	**60**	

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Section A – Mechanics

01 A particle moves along the x-axis so that its velocity v ms^{-1} at time t seconds is given by $v = 3t^2 - 6t - 2$

At time $t = 2$, the particle's displacement from the origin is -3 m.

Find an expression for the displacement of the particle at time t seconds.

[3 marks]

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02

$$\overrightarrow{OA} = 3\mathbf{i} - \mathbf{j}$$

$$\overrightarrow{OB} = 5\mathbf{i} + 4\mathbf{j}$$

a) Find the magnitude of $\overrightarrow{AB}$.

[3 marks]

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b) Find the angle $\overrightarrow{AB}$ makes with the positive x-axis.

[2 marks]

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03 A footballer kicks a football vertically upwards.

At the instant the ball leaves their foot, it is 0.4 m above the ground and has a velocity of 2 5m/s.

The motion of the football is modelled as a particle moving freely under gravity, where g = 9.8 ms^{-2}.

a) Find the velocity of the ball when it hits the ground.

[3 marks]

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b) Find the maximum height reached by the ball.

[2 marks]

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04 A car of mass 1000 kg tows a trailer, of mass 250 kg using a horizontal tow bar.

The car and the trailer move in a straight line along a horizontal road with constant acceleration.

The trailer experiences a resistive force equal to F and the car experiences a resistive force with a magnitude 4F.

The car starts from rest and travels 30m in 10s.

The engine of the car produces a driving force of 1500N in the horizontal direction.

Find the value of F.

[6 marks]

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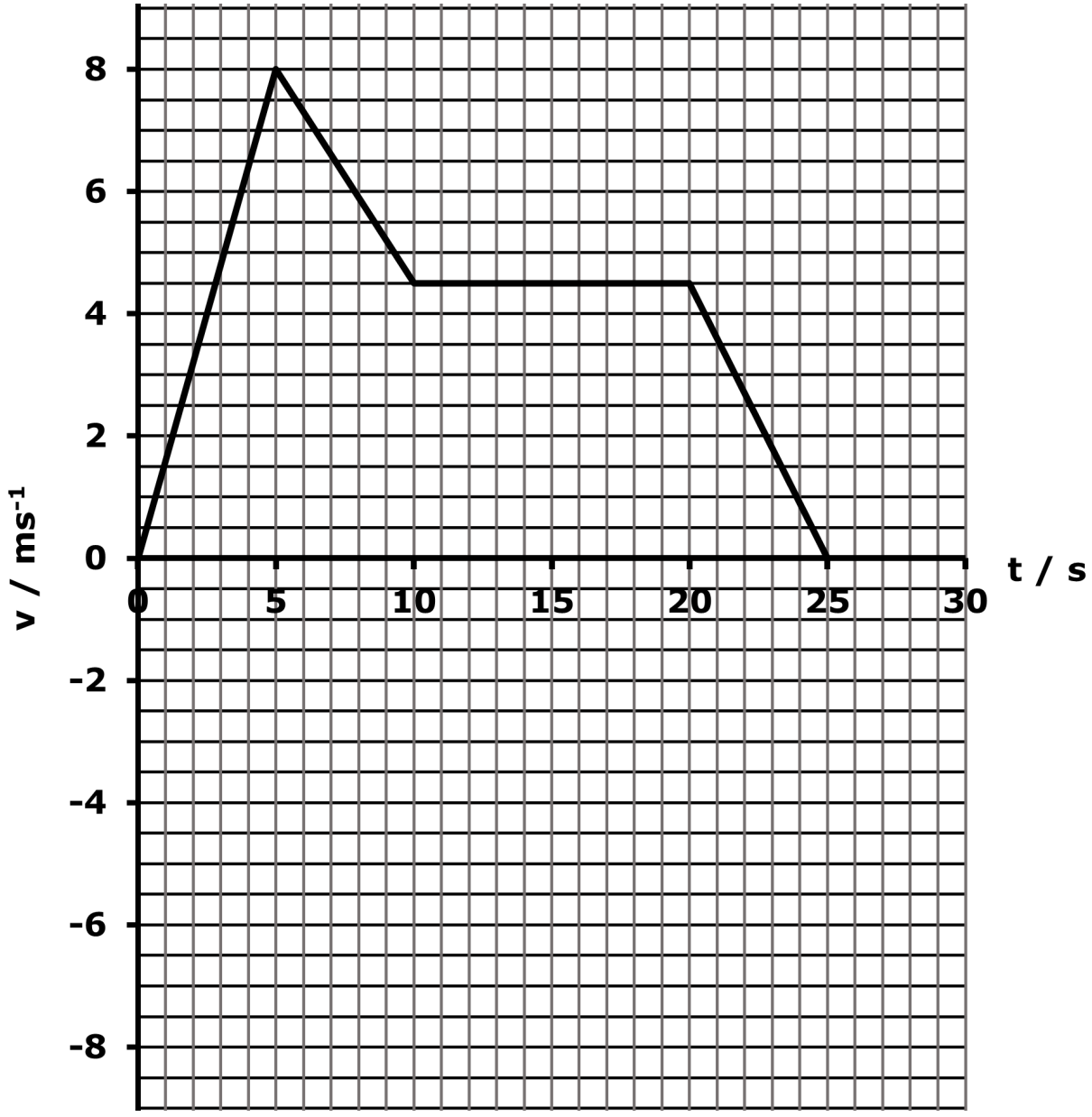
05 A car is travelling in a straight line.

The velocity-time graph below shows its motion between 0 seconds and 25 seconds.



a) Work out the acceleration of the car between 5 and 10 seconds.

[2 marks]

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b) Work out the total distance travelled by the car between 0 seconds and 20 seconds.

[3 marks]

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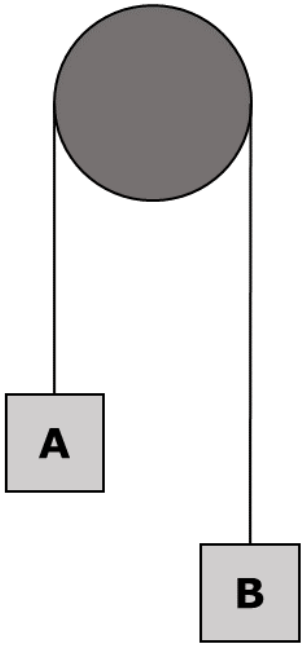
06 Two boxes, A and B, of masses m and km respectively (where $k > 1$) are connected to a light, inextensible string over a smooth pulley.



The boxes move with an acceleration of $\frac{7g}{8}$.

a) Find the tension in the string in terms of m and g.

[2 marks]

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b) Find the value of the constant k.

[3 marks]

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c) The pulley is modelled as being smooth.
Give the assumption that can be made when the pulley is modelled as smooth.

[1 mark]

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Section B – Statistics

07 A student threw a fair dice 25 times.

After each throw they record the number of the dice.

The student wants to model the number of times the dice lands on 6.

a) Write down the distribution used to model the number of times the dice lands on 6.

[1 mark]

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b) Give **two** reasons why the number of times the dice lands on 6 can be modelled using this distribution.

[2 marks]

1)……

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2)……

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c) Find the probability the dice lands on 6:

i) Exactly 25 times.

[1 mark]

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ii) At least 5 times.

[2 marks]

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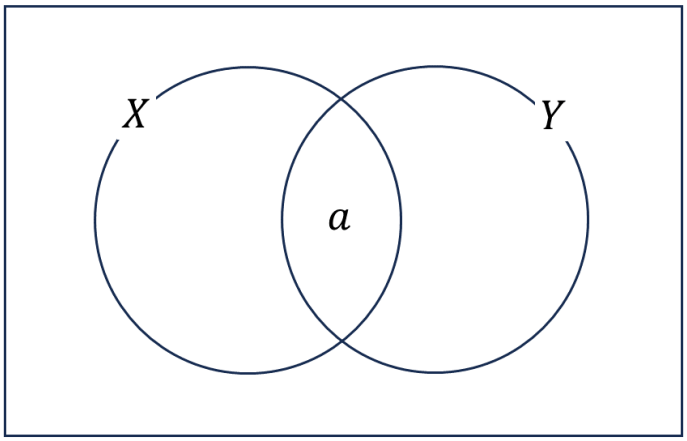
08 X and Y are two events.

It is known that $P(X) = 0.3$, $P(Y) = 0.25$ and $P(not\ X\ and\ not\ Y) = 0.6$.



a) Work out the value of a.

[3 marks]

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b) Determine if the events of X and Y are independent.

[2 marks]

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09 A teacher wanted to investigate how long their students were studying for class tests.

The teacher asked all the students in his lesson how long they spent studying for a maths test.

The teacher than recorded this information in the table below:

Amount of time spent studying for test (minutes)	9-19	20-29	30-39	40-49	50-59
Frequency	14	4	3	5	1

The midpoint of each class was represented by x and its corresponding frequency was represented by f to give:

$$\sum fx = 681.5$$

$$\sum fx^2 = 21786.75$$

a) Use linear interpolation to find to estimate for the median time spent studying for the class test.

[3 marks]

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b) Estimate the mean and standard deviation of the data.

[2 marks]

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10 20 people were asked their height and weight using opportunity sampling.

The heaviest person in the sample weighed 85.2kg.
The lightest person in the sample weighed 61.3kg.

a) Give an advantage and disadvantage of using opportunity sampling.

[2 marks]

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A linear regression line of weight against height was found using the data received from these 20 people:

$$w = 36.4 + 0.25h$$

Where h is height measured in cm and w is weight measured in kg.

b) Give an interpretation of the gradient of the regression line.

[1 mark]

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c) Suggest how we could we improve this model.

[1 mark]

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d) This model is not always appropriate.
Suggest why.

[1 mark]

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e) Using the linear regression model, work out the expected height of a person who weighs 120kg.

Comment on the validity of your answer.

[2 marks]

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11 Before any training, a sales company converts a sale in 1 of every 15 calls.

After the staff of the sales company take a training course the company believe more calls will convert to sales.

The company collects data on the next 40 calls and 3 of them converted to sales.

Test the companies claims, to the 5% level of significance, that the training has increased sales conversions.
State your hypothesis clearly and include the test statistic in your answer.

[6 marks]

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END OF QUESTIONS

MARKING GUIDANCE

Question	Solution
1	A2M for integration $x = t^3 - 3t^2 - 2t + c$ (A1M for two terms) A1M for finding c using substitution and final expression $-3 = (2)^3 - 3(2)^2 - 2(2) + c$ $x = t^3 - 3t^2 - 2t + 5$
2 (a)	A1M for attempting $\overrightarrow{OB} - \overrightarrow{OA} = \overrightarrow{AB} = 2\mathbf{i} + 5\mathbf{j}$ A1M for using Pythagoras' Theorem $\lvert\overrightarrow{AB}\rvert = \sqrt{(2)^2 + (5)^2}$ A1M for $\sqrt{29}$
2 (b)	A1M for tan θ = $\frac{5}{2}$ A1M for 68.2°
3 (a)	A1M for use of $v^2 = u^2 + 2as$ A1M for substitution $v^2 = 25^2 + 2 \times (-9.8) \times (-0.4)$ A1M for $v = 25.16\, ms^{-1}$
3 (b)	A1M for substitution $0^2 = 25^2 + 2 \times (-9.8) \times s$ A1M for s = 32.28m
4	A1M for use of suvat: $s = ut + \frac{1}{2}at^2$ A1M for correct substitution $30 = 0 \times 10 + \frac{1}{2}a \times 10^2$ A1M $a = 0.6ms^{-2}$ A1M for resolving forces on total system $1500 - 5F = 1250a$ A1M for correct substitution $1500 - 5F = 1250\, x\, 0.6\; OR\; 1500 - 5F = 750$ A1M $F = 150N$
5 (a)	A1M for attempt to calculate gradient between t = 5s and t = 10s. e.g. $\frac{8-4.5}{5}$ OR correct use of SUVAT equation A1M for -0.7 ms^{-2} **OR** deceleration of 0.7 ms^{-2}

5 (b)	A1M for area of first 5 seconds ½(5)(8) = 20 A1M for area of next 5 seconds ½(5)(8 + 4.5) = 31.25 A1M for total area 20 + 31.25 + 45 = 96.25m
6 (a)	A1M for T – mg = m x 7g/8 A1M for T = 15mg/8
6 (b)	A1M kmg – T = kma A1M for $kmg - \frac{15mg}{8} = \frac{7mg}{8}$ or equivalent A1M for k = 15
6 (c)	A1M the tension is the same throughout the string
7 (a)	A1M for $X \sim B\left(25, \frac{1}{6}\right)$
7 (b)	A2M for any **two** from: There are a fixed number of trials There are two possible outcomes (6 or not 6) There is a fixed probability of success The trials are independent of each other
7 (ci)	A1M for $P(X=25) = (1/6)^{25}$ or 3.52×10^{-20}
7 (cii)	A1M for $P(X \geq 5) = 1 - P(X \leq 4)$ A1M for 0.4063
8 (a)	A1M for 1 – 0.6 = 0.4 A1M for 0.4 = 0.3 + 0.25 – a A1M for a = 0.15
8 (b)	A1M for P(X) × P(Y) = 0.3 × 0.25 = 0.075 A1M for 0.075 does not equal 0.15 (the probability of A and B), therefore not independent
9 (a)	A1M for $Q_2 = \frac{13.5}{14} \times 11 + 8.5$ or alternative method A1M for 19.1…
9 (b)	A1M for Mean = 25.2 (1 d.p.) A1M for Standard deviation = $\sqrt{\frac{21786.75}{27} - \left(\frac{681.5}{27}\right)^2}$ A1M for Standard deviation = 13.03 (2 d.p)
10 (a)	A1M for <u>Advantage</u> Any **one** from Easy to carry out Not expensive A1M for <u>Disadvantage</u> Unlikely to be representative Accept other correct advantages or disadvantages
10 (b)	A1M for Every 1 cm increase in height gives 0.25 extra kg in weight.
10 (c)	A1M for larger sample size
10 (d)	A1M for it gives weights for unrealistic heights e.g. 0cm = 36.4kg

10 (e)	A1M for 334.4 cm A1M requires extrapolation outside of dataset so less likely to be valid
11	A1M for test statistic: X is the number of calls that convert to sales A1M for $X \sim B\left(40, \frac{1}{15}\right)$ A1M for $H_0: p = \frac{1}{15}$ AND $H_1: p > \frac{1}{15}$ A1M for $P(X \geq 3) = 0.50386 \ldots$ A1M for $0.50386 > 0.05$ A1M for There is not enough evidence to reject the null hypothesis (the training has not increased the number of calls that convert to sales).
Total	**60**