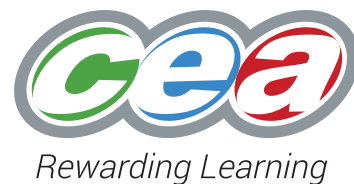


GCE



Revised GCE

Mathematics

Assessment Unit AS 2

assessing

Applied Mathematics

Practice Paper and Mark Scheme

For first teaching from September 2018
For first award of AS Level in Summer 2019
For first award of A Level in Summer 2019



Centre Number

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Candidate Number

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ADVANCED SUBSIDIARY (AS)
General Certificate of Education

Mathematics

Assessment Unit AS 2

Assessing

Applied Mathematics

[SMT21]

PRACTICE PAPER

TIME

1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages or tracing paper.

Complete in black ink only. **Do not write with a gel pen.**

Questions which require drawing or sketching should be completed using an HB pencil.

Candidates must answer **all** questions from sections A and B.

Equal time should be spent on each section.

Show clearly the full development of your answers. **Answers without working may not gain full credit.**

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70. The total available mark for each section of this paper is 35.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Answers should include diagrams where appropriate and marks may be awarded for them.

Take $g = 9.8\text{ms}^{-2}$, unless specified otherwise.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is $\ln z$ where it is noted that $\ln z \equiv \log_e z$

Answer all questions

SECTION A

Mechanics

1. Forces of magnitude 2N, 6N, 5 N act along the sides BA, BC, CA, respectively, of a right-angled triangle ABC as show in **Fig.1** below.

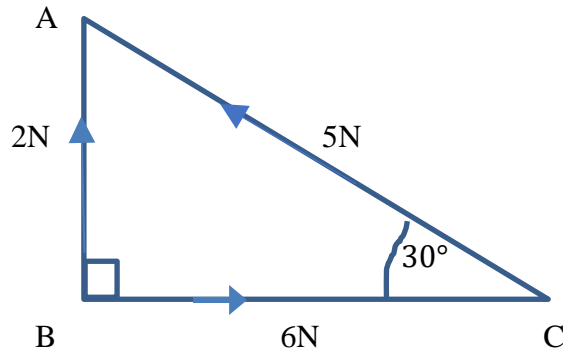


Fig.1

$\widehat{ABC} = 90^\circ$

$\widehat{BCA} = 30^\circ$

Find the magnitude of the resultant force.

[6]

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2. **Fig.2** below shows two identical baskets, A and B, each of mass 2kg connected by a light, inelastic string which passes over a smooth fixed pulley.

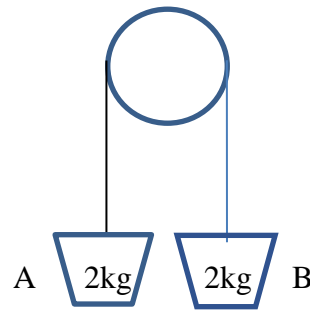


Fig.2

A 4kg box is placed in basket A and the baskets are released from rest.

While they are in motion find:

- (i) acceleration of basket A;

[5]

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3. Fig.3 below shows a skier being pulled up a snow slope inclined at 60° to the horizontal by a rope parallel to the slope.

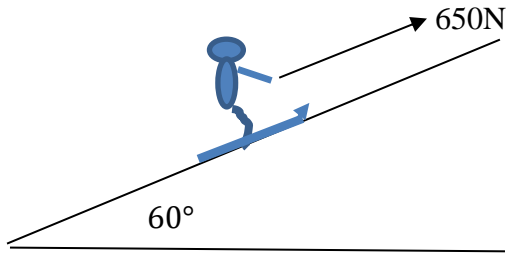
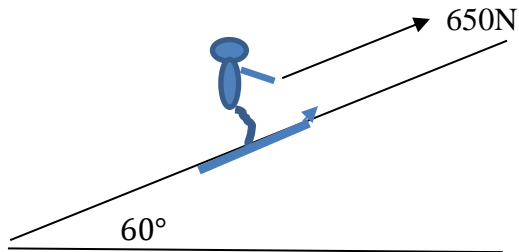


Fig.3

The skier is travelling with constant speed of 2ms^{-1} and the tension in the rope is 650N . The coefficient of friction between the skier and the slope is μ . Model the skier and her skis as a particle of mass 65kg .

(i) Complete the diagram below showing all the forces acting on the skier. [2]



(ii) Find μ . [7]

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The skier lets go of the rope when she is d metres from the top of the slope.

(iii) Find the maximum value d so that she reaches the top of the slope. [4]

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SECTION B

Statistics

5. Two independent events X and Y are such that $P(X) = 0.64$ and $P(X \cap Y) = 0.32$

(i) Find $P(Y)$

[2]

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(ii) Show that X and Y are not exhaustive.

[4]

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6 (i) State two necessary conditions when modelling using a Binomial distribution. [2]

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A cashier in a bank observes whether customers sign with their left or right hand.

It is known that 90% of the population are right-handed.

(Assume the customers are either left-handed or right-handed.)

There is a queue of ten customers for the cashier.

Find the probability that:

(ii) the first customer is left-handed; [1]

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(iii) six of the customers are left-handed; [3]

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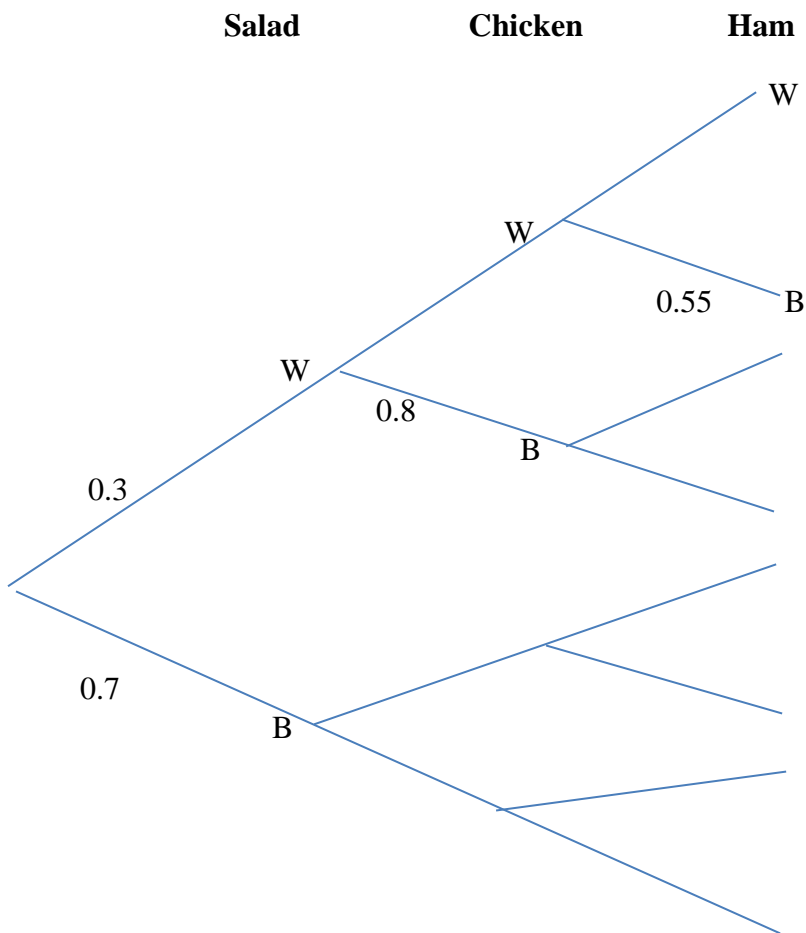
7. The supermarket sells three types of sandwiches: salad, chicken, and ham.

The sandwiches are made with either white or brown bread.

The manufacturer uses the brown bread for 70% of salad sandwiches, 80% of chicken sandwiches and 55% of ham sandwiches.

(i) Complete the tree diagram below.

[2]



Bill randomly chooses 3 sandwiches: one salad, one chicken and one ham.

- (ii) Find the probability that two of his sandwiches are made with brown bread and the other with white bread. [5]

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- (iii) Find the probability that at least one of his sandwiches is made with white bread. [3]

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8. A used car dealer stocked his show room with various makes of car.

The dealer priced his cars such that the lower the mileage the more expensive the car.

He decided to check his pricing method by investigating the strength of the relationship between the mileage of a car and the price.

(i) Explain to the dealer how to use random sampling with random number tables to sample 30 cars from a stock of 100 cars

[2]

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The mileage (to the nearest 1000 miles) and associated price of this sample of 30 of the cars in the show room are presented on the scatter diagram shown in **Fig. 4** below.

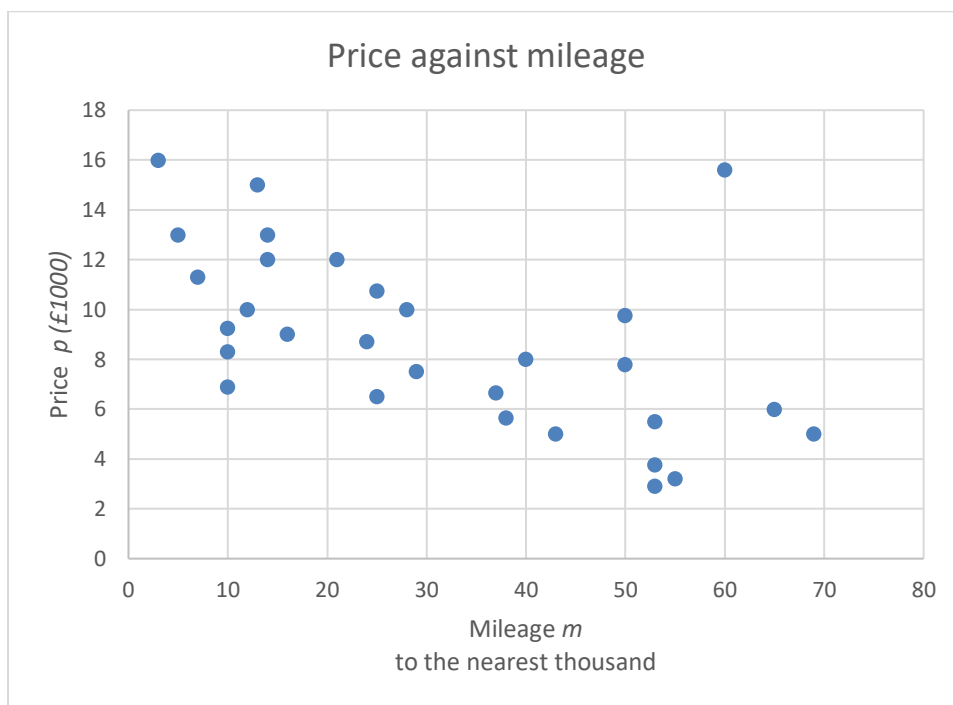


Fig.4

The following are summary statistics:

$$\sum m = 932 \quad \sum p = 263.904 \quad \sum m^2 = 40536 \quad \sum p^2 = 2693.954$$
$$\sum mp = 6996.725 \quad S_{mm} = 11581.87 \quad S_{pp} = 372.4429 \quad S_{mp} = ?$$

- (ii) Calculate the missing S_{mp} value and hence find the product-moment correlation coefficient between the mileage and price.

[4]

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- (iii) Suggest how the car dealer might attempt to interpret the value calculated in (ii).

[2]

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- (iv) Identify any item of data on the scatter graph in **Fig.4** that might have unduly influenced the calculation in (ii).

[1]

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THIS IS THE END OF THE PAPER

ADVANCED

General Certificate of Education

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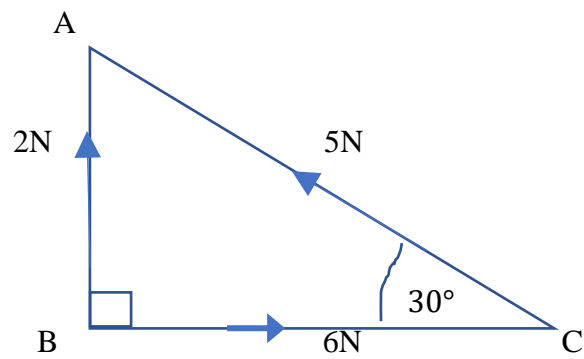
Applied Mathematics

[SMT21]

PRACTICE PAPER

**MARK
SCHEME**

1.



Resolve Parallel to BC

$$X = 6 - 5 \cos 30^\circ = 1.66987$$

M1W1

Resolve Parallel to BA

$$Y = 2 + 5 \cos 60^\circ = 4.5$$

M1W1

$$R = \sqrt{(1.66987)^2 + (4.5)^2}$$

M1

$$= \sqrt{(1.66987)^2 + (4.5)^2}$$

$$= 4.80 \text{ N}$$

W1

AVAILABLE
MARKS

6

2(i)

Box A

$$F = ma$$

$$6g - T = 6a$$

M1W1

Box B

$$F = ma$$

$$T - 2g = 2a$$

MW1

Combining

$$6g - T = 6a$$

$$\underline{T - 2g = 2a}$$

$$4g = 8a$$

M1

$$a = \frac{g}{2} = 4.9\text{ms}^{-2}$$

W1

(ii) $4g - R = 4 \times \frac{g}{2}$

M1W1

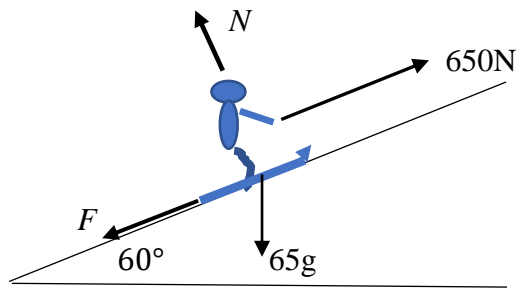
$$R = 2g = 19.6\text{N}$$

W1

8

AVAILABLE
MARKS

3. (i)



AVAILABLE
MARKS

MW2

(ii) Resolve parallel to plane

$$650 = 65g \cos 30^\circ + F$$

M1

$$F = 650 - 65g \cos 30^\circ = 98.3418 = 98.3\text{N}$$

W1

Resolve Perpendicular to plane

$$N = 65g \cos 60^\circ$$

M1W1

$$\text{Friction} = \mu N$$

M1

$$98.3418 = 65\mu g \cos 60^\circ$$

W1

$$\mu = 0.309$$

W1

(iii)

$$-65g \cos 30^\circ - 98.3418 = 65a$$

M1

$$-650 = 65a$$

$$a = -10 \text{ ms}^{-2}$$

W1

$$v^2 = u^2 + 2ad$$

M1

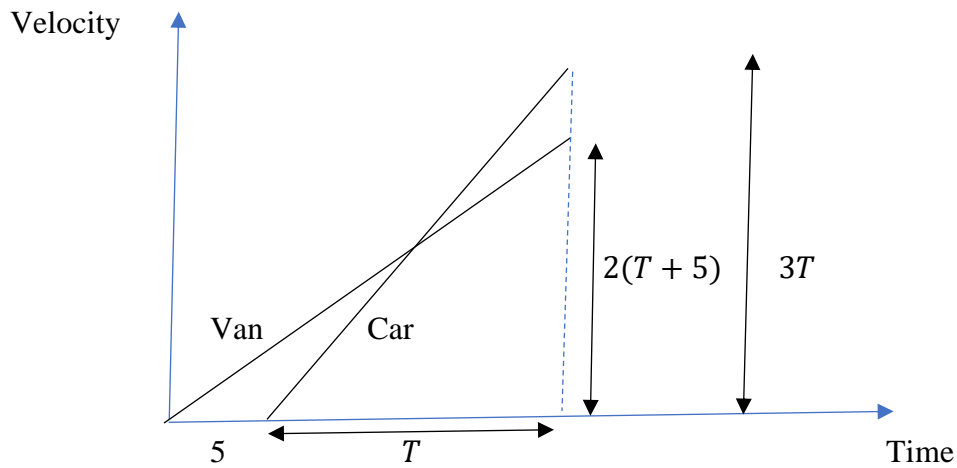
$$0 = 4 - 20d$$

$$d_{\text{max}} = d = 0.2$$

MW1

13

4.



AVAILABLE MARKS

Van $s = ut + \frac{1}{2}at^2$ M1
 $s_{\text{van}} = \frac{1}{2}(2)(T + 5)^2$ W1 MW1

Car $s = ut + \frac{1}{2}at^2$
 $s_{\text{car}} = \frac{1}{2}(3)T^2$ MW1

$s_{\text{van}} + 37.5 = s_{\text{car}}$ MW1

$\frac{1}{2}(2)(T + 5)^2 + 37.5 = \frac{1}{2}(3)T^2$ M1

$(2)(T + 5)^2 + 75 = (3)T^2$

$T^2 - 20T - 125 = 0$ W1

$(T + 5)(T - 25) = 0$

$T = 25$

$t = 30$

MW1 8

5.(i)

Independent implies $P(X \cap Y) = P(X)P(Y)$

$$0.32 = 0.64P(Y)$$

$$P(Y) = 0.5$$

(ii) If exhaustive $P(X \cup Y) = 1$

$$\begin{aligned} P(X \cup Y) &= P(X) + P(Y) - P(X \cap Y) \\ &= 0.64 + 0.5 - 0.32 \\ &= 0.82 \neq 1 \end{aligned}$$

So X and Y are not exhaustive.

AVAILABLE
MARKS

M1

W1

M1

M1

W1

W1

6

6.

(i) Independent trials.
 Constant probability of success.
 Only two possible outcomes.
 Finite number of trials.
 (Give any two) MW2

(ii) $P(\text{left-handed}) = 1 - P(\text{right-handed}) = 1 - 0.9 = 0.1$ MW1

(iii) $X \sim \text{Bin}(10, 0.1)$ M1
 $P(X = 6) = 0.000138$ M1W1

(iv) Let X be the random variable “the number of left-handed customers”
 $X \sim \text{Bin}(10, 0.1)$ M1
 $P(X \geq 4) = 1 - P(X \leq 3)$ M1

Calculator Use: Binomial Probability Cumulative function with
 $n = 10, p = 0.1$ and $x = 3$

$P(X \leq 3) = 0.9872048..$ MW1

$P(X \geq 4) = 1 - P(X \leq 3) = 0.0127952 = 0.0128$ (3sf) W1

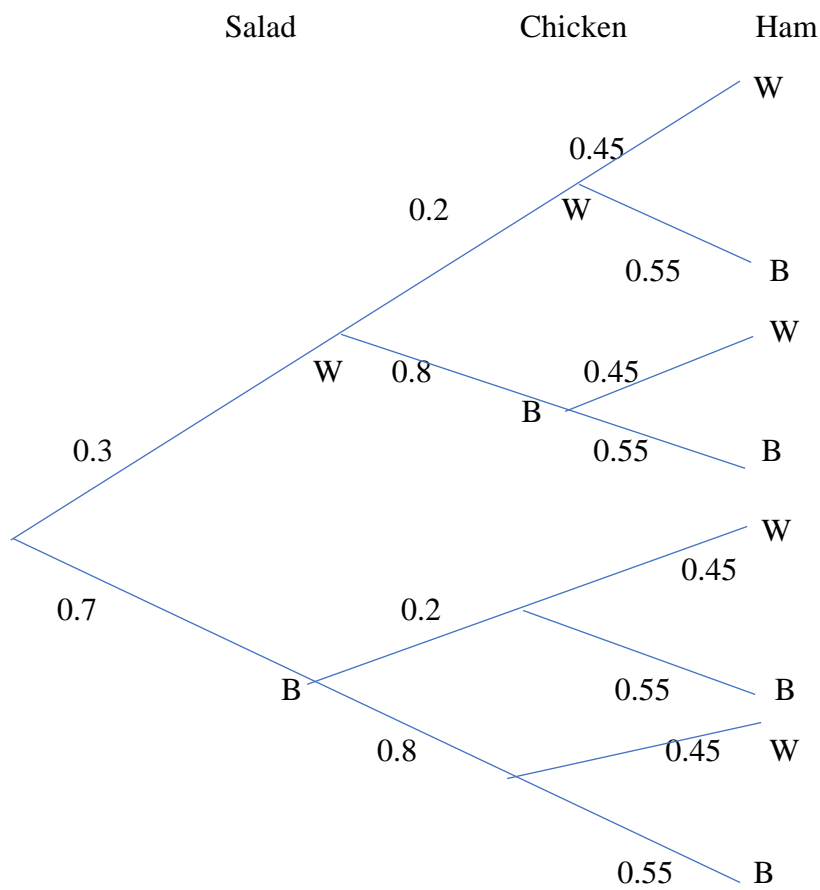
Alternative solution

$P(X \leq 3) = P(X = 0) + P(X = 1) + P(X = 2) + P(X = 3)$
 $= 0.9872048..$ MW1

AVAILABLE
MARKS

10

7(i)



MW2

(ii)

$$\begin{aligned}
 P(2 \text{ B and } 1 \text{ W}) &= P(\text{BBW}) + P(\text{BWB}) + P(\text{WBB}) \\
 &= 0.7 \times 0.8 \times 0.45 + 0.7 \times 0.2 \times 0.55 + 0.3 \times 0.8 \times 0.55 \\
 &= 0.461
 \end{aligned}$$

M1

W3

W1

(iii)

$$\begin{aligned}
 P(\text{At least one is W}) &= 1 - P(\text{BBB}) \\
 &= 1 - 0.308 \\
 &= 0.692
 \end{aligned}$$

M1

W1

W1

AVAILABLE MARKS

10

8 (i) Allocate a 2-digit number to each car. MW1

If for example the first row of tables is

1 5 6 2 5 8 4 6 9

you can start at the beginning of the first row and select cars with the associated numbers.

15, 62, 58 etc

Continue to the second row etc. until you have 30 cars selected. MW1

Ignore any repetitions.

$$(ii) S_{mp} = \sum mp - \frac{\sum m \sum p}{n} = 6996.725 - \frac{932 \times 263.904}{30}$$

$$= -1201.89$$

M1
W1

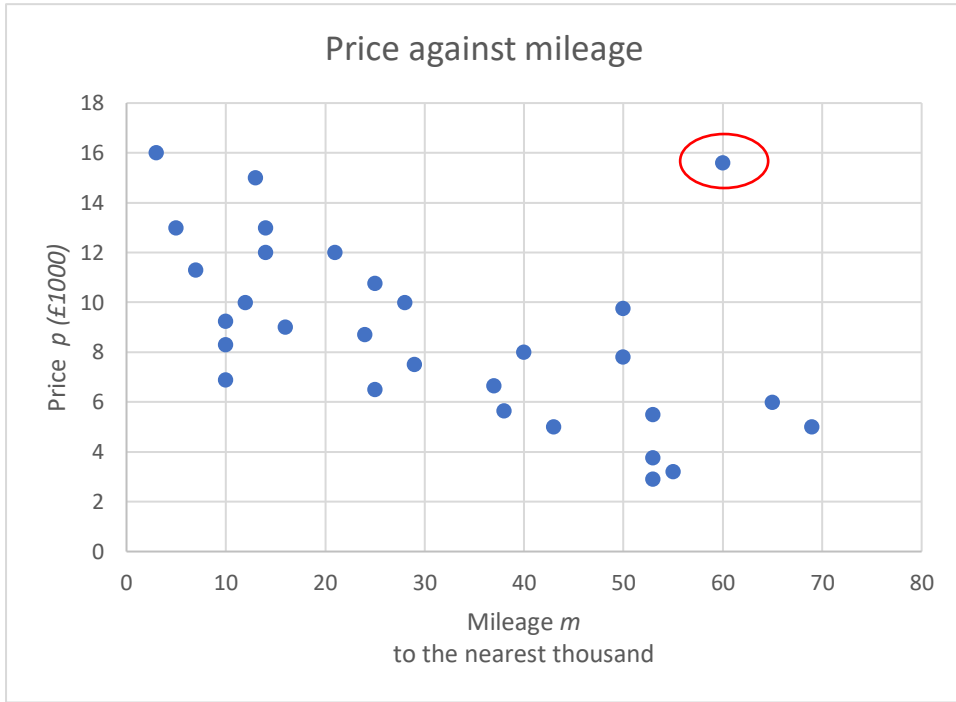
$$r = \frac{S_{mp}}{\sqrt{S_{mm}}\sqrt{S_{pp}}} = \frac{-1201.89}{\sqrt{11581.87}\sqrt{372.4429}}$$

$$= -0.579 \text{ (3sf)}$$

M1
W1

(iii) There is some negative correlation between the mileage and the price of the car. MW2

(iv)



MW1

9

Total

70

AVAILABLE MARKS

