IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper P

Difficulty Rating: 3.3633/0.7585

Time: 3 hours

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 14 questions in this question paper.
The total mark for this paper is 150.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

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SECTION 1 - STATISTICS

Question 1

The table below shows the number of Maths teachers x, working in 8 different towns and the number of burglaries y, committed in a given month in the same 8 towns.

Town	A	B	C	D	E	F	G	H
x	35	42	21	55	33	29	39	40
y	30	28	21	38	35	27	30	k

a) Use a statistical calculator to find the product moment correlation coefficient between the number of maths teachers and the number of burglaries, for the towns A to G. **(1)**

b) Interpret the value of the product moment correlation coefficient in the context of this question. **(1)**

c) Test, at the 5% level of significance, whether there is evidence of positive correlation between the number of maths teachers and the number of burglaries, for the towns A to G. **(3)**

d) Comment on the statement

"… the Maths teachers are likely to be responsible for the burglaries …" **(1)**

e) Use linear regression to estimate the value of k, for town H. **(3)**

Question 2

The following set of data shows the number of posts made, in a given day, in a social media site by a group of individuals.

$$1,\ 12,\ 13,\ 14,\ 16,\ 17,\ 20,\ 21,\ 23,\ 24,\ 26,\ 39,\ 55.$$

For this set of data, ...

a) ... determine the value of the median and the quartiles. **(3)**

b) ... calculate the mean and the standard deviation. **(4)**

c) ... determine with justification whether there are any outliers. **(3)**

d) ... state with justification if there is any type of skew. **(2)**

Question 3

The events A and B satisfy

$$\mathrm{P}(A)=0.45,\qquad \mathrm{P}(A\cap B')=0.25,\qquad \mathrm{P}(A\cup B)=0.8.$$

a) Illustrate the above information in a fully completed Venn diagram. **(2)**

b) Determine …

i. … $\mathrm{P}(A|B')$. **(2)**

ii. … $\mathrm{P}(B'|A')$ **(2)**

c) Find $\mathrm{P}(A\cap B'|A'\cup B')$. **(4)**

Question 4

The weights of baking apples are thought to be Normally distributed.

2.5% of these apples are heavier than 250 grams and 1% are lighter than 144 grams.

a) Find the mean and the standard deviation of the weights of baking apples, according to this model, giving the answers correct to the nearest integer. **(6)**

You may use the mean and standard deviation found in part **(a)** to answer part **(b)**.

b) Given a baking apple weighs more than 227 grams, determine the probability it weighs more than 250 grams. **(5)**

Question 5

The discrete random variable X represents the number of households with satellite TV subscriptions.

It is assumed that X follows a binomial distribution $\mathrm{B}(n, 0.35)$.

a) If $n = 25$, find the probability ...

i. ... $\mathrm{P}(X = 12)$. **(2)**

ii. ... $\mathrm{P}(X > 12)$. **(2)**

b) If $n = 25$, determine the probability

$$\mathrm{P}\left[\mathrm{E}(X) - \sqrt{\mathrm{Var}(X)} < X < \mathrm{E}(X) - \sqrt{\mathrm{Var}(X)}\right]. \quad \textbf{(5)}$$

c) Find the smallest number of households that must be sampled so that the probability of having at least a household with satellite TV subscription is greater than 99%. **(5)**

An analyst believes that the proportion of households with satellite TV subscription is higher, because in a sample of 25 households 13 had a satellite TV subscription.

d) Using a clear method, test the analyst's belief, at the 99% level of significance. **(6)**

Question 6

Dora, Tina and Flora are three girls which train daily in their local gym.

Dora's and Tina's daily attendances are independent of one another, with respective probabilities of 0.9 and 0.8.

Flora is Tina's friend, which also trains in the same gym as Tina.

The probability that Flora trains on any given day is 0.7 if Tina also trains on that day, but it is 0.4 if Tina does not train on that day.

a) Find the probability that on a given day ...

i. ... all three girls train. **(2)**

ii. ... only two of the three girls train. **(3)**

b) Determine the probability that on a given day...

i. ... if Flora trained, then Dora and Tina also trained. **(2)**

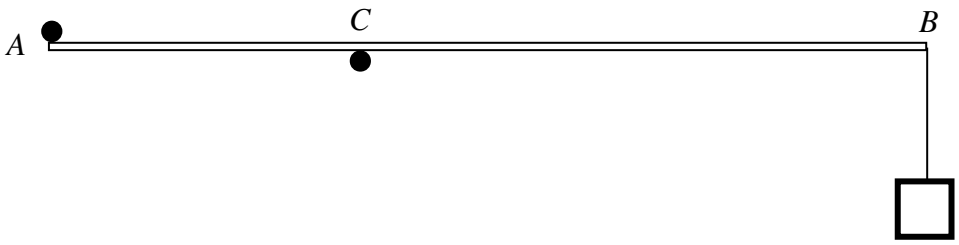
ii. ... if Dora and Tina trained, then Flora also trained. **(2)**

iii. ... if Tina trained, then Dora and Flora also trained. **(2)**

iv. ... if Tina and Flora trained, then Dora also trained. **(2)**

SECTION 2 - MECHANICS

Question 7



A box of mass 76 kg is attached by a string to one end B of a uniform rod AB of length 5 m and mass 24 kg.

The rod is held horizontally in equilibrium by two smooth cylindrical pegs, one at A and one at C, where $|AC| = 2$ m, as shown in the figure above.

Calculate the magnitude of the forces exerted by each of the pegs onto the rod. **(7)**

Question 8

A lift, of mass M kg, is lifted up a vertical mineshaft by a cable attached to the top of the lift. A man of mass m kg is standing inside the lift.

The lift is accelerating with constant acceleration of $0.8\ \text{ms}^{-1}$.

The man experiences a constant normal reaction of magnitude 901 N from the floor of the lift and there is a constant tension of 17861 N in the cable of the lift.

Determine the value of m and the value of M. **(7)**

Question 9

A particle is projected vertically upwards from a balcony which is 2.48 m above level horizontal ground.

The particle is moving freely under gravity, takes 2.45 s to reach the highest point in its path, before it strikes the ground with speed v ms^{-1}.

Calculate the value of v. **(7)**

Question 10

A particle is projected from a point O on level horizontal ground with speed of 23.8 ms^{-1} at an angle ψ to the horizontal, where $\tan\psi = \frac{15}{8}$.

The particle is moving freely under gravity, reaching a greatest height of H m above the ground before it lands on the ground at a point A.

a) Determine the distance OA **(6)**

b) Find the value of H. **(3)**

c) Calculate, to three significant figures, the speed of the particle when it is at a height of 20 m above the ground. **(6)**

Question 11

A uniform ladder AB, of length 12 m and mass M kg, is placed with its end A on rough horizontal ground and B against a smooth vertical wall.

A light inextensible rope is attached to the ladder at a vertical distance of 3 m **above the ground** and is tied to the wall so that the rope is horizontal. The rope can withstand a maximum tension of 490 N.

The ladder is inclined at $\arctan\frac{4}{3}$ to the horizontal and the coefficient of friction between the ladder and the ground is $\frac{1}{4}$.

Given that the rope breaks when a man of mass 100 kg is standing at the point P on the ladder, where $|AP| = 9$ m, find the value of M. **(9)**

Question 12

A model ship A is moving in a straight line with constant velocity, on the calm water of a pond. Relative to a fixed origin O the horizontal unit vectors $\mathbf{i}$ and $\mathbf{j}$ are pointing due east and due north, respectively.

At time $t = 0$ s its position vector of A is $(-2\mathbf{i} + 3\mathbf{j})$ m and when $t = 5$ s its position vector is $(13\mathbf{i} - 7\mathbf{j})$ m.

a) Find an expression for the position vector of A at time t s. **(5)**

When $t = 10$ another model ship B passes through the point with position vector $(8\mathbf{i} + 3\mathbf{j})$ m and travels with constant velocity $\mathbf{V}$ ms^{-1}.

b) Given that the two model ships collide when $t = 30$, determine an expression for $\mathbf{V}$ in the form $u\mathbf{i} + v\mathbf{j}$. **(5)**

Question 13

A car starts from rest at some point A and accelerates uniformly at 1.5 ms^{-2} for 20 s.

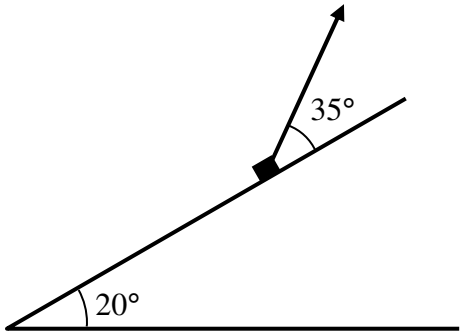
The car then continues at constant speed.

A motorbike also starts from rest from point A, 10 s **after** the car left A.

The motorbike accelerates uniformly at 2 ms^{-2} overtaking the car with speed V.

Determine the value of V. **(10)**

Question 14



A box of mass 60 kg is held in limiting equilibrium, on a fixed rough inclined plane, by a rope. The plane is at an angle of $20°$ to the horizontal, as shown in the figure above.

The rope lies in a vertical plane containing a line of greatest slope of the incline plane and is inclined to the plane at an angle $35°$.

The rope is modelled as a light inextensible string and the box is modelled as a particle. The coefficient of friction between the box and the plane is $\frac{1}{4}$.

Determine the **least** possible tension in the rope. **(10)**