IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper Q

Difficulty Rating: 3.1400/0.6993

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 16 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 number of phone text messages send by 11 different students is given below.

$$14,\ 25,\ 31,\ 36,\ 37,\ 41,\ 51,\ 52,\ 55,\ 79,\ 112.$$

a) Find the lower quartile, the median and the upper quartile of the data. **(3)**

b) Show clearly that there is only one outlier in the data. **(3)**

c) Draw a suitably labelled box plot for this data, clearly indicating any outliers. **(3)**

d) Determine with justification the skewness of the data. **(2)**

Question 2

The events A and B are such so that

$$\mathrm{P}(A\cap B')=0.25,\quad \mathrm{P}(A)=2\mathrm{P}(B)\quad \text{and}\quad \mathrm{P}(A\cup B)=0.45.$$

Determine …

a) … $\mathrm{P}(A\cap B)$. **(5)**

b) … $\mathrm{P}(A\cup B')$. **(2)**

Question 3

The table below shows the marks obtained by a group of students, in two separate tests.

Student	A	B	C	D	E	F	G	H
Test 1	28	39	18	30	42	43	33	10
Test 2	12	23	16	16	28	18	24	7

The first test is out of 50 marks while the second test is out of 30 marks.

Let x and y represent the marks obtained in Test 1 and Test 2, respectively.

a) Use a statistical calculator to find the value of the product moment correlation coefficient between x and y. **(1)**

b) Explain how the value of the product moment correlation coefficient between x and y will be affected if the individual test marks were converted into percentage marks. **(1)**

c) Test, at the 1% level of significance, whether there is evidence of positive correlation between x and y. **(3)**

A student was absent from the second test but he obtained 30 marks in the first test.

d) Use linear regression to estimate this student's mark in the second test. **(3)**

Question 4

The random variable Y is Normally distributed with mean μ and variance σ^2.

Given that $\mathrm{P}(Y<48)=\mathrm{P}(Y>57)=0.0668$, find the value of $\mathrm{P}(50.1<Y<55.8)$. **(9)**

Question 5

A test is developed to determine whether someone has or has not got a disease, which is known to be present in 3% of the population.

Given a person has the disease the test is positive with probability of 98%.

Given a person does not have the disease the test is positive with probability of 5%.

a) Draw a tree diagram to represent this information. **(2)**

A person is selected at random from the population and tested for the disease.

b) Find the probability that this person's test is positive. **(3)**

A person who tested positive is selected.

c) Find the probability that the person does not have the disease. **(3)**

d) Comment on the effectiveness of this test with reference to the answer given in part **(c)**. **(1)**

Question 6

The records in a dentist's surgery show that 15% of the patients that make an appointment fail to turn up.

a) In a day with 15 appointments determine the probability that …

i. … exactly 2 patients will fail to turn up. **(2)**

ii. … at least 2 patients will fail to turn up. **(2)**

b) Use a distributional approximation to find the probability that in a month with 400 appointments, more than 45 but at most 65 patients will fail to turn up. **(6)**

The surgery administrator feels that the percentage of patients that make an appointment and fail to turn up is likely to change in the future. The surgery tries an automated system of generating message reminders on patients' mobile phones.

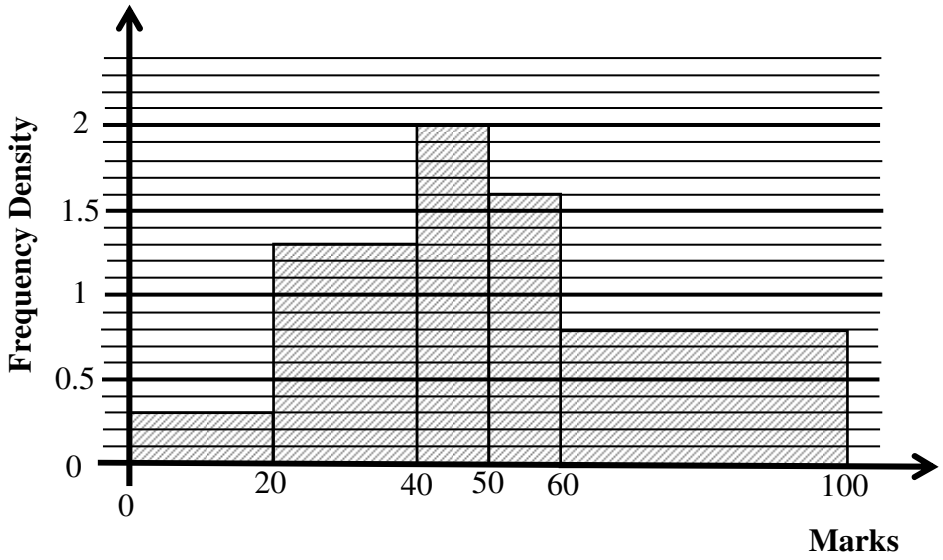
It is required to find whether the proportion of patients that fail to turn up is different from 15% , by monitoring the next 20 appointments.

c) Determine the critical region for this test, at the 10% level of significance. **(5)**

d) Write down the critical region for the same test if the probability of rejecting at either tail is as close as possible to 5% . **(1)**

Question 7

The histogram below shows the distribution of the marks of 250 students.



a) Estimate how many students scored between 52 and 74 marks. **(6)**

b) Use the histogram estimate the median. **(3)**

c) Calculate estimates for the mean and standard deviation of the marks of these students. **(6)**

SECTION 2 – MECHANICS

Question 8

A car of mass 1200 kg is travelling at a speed of 28 ms^{-1} along a straight horizontal road when the driver applies the brakes and a constant braking force of 2100 N acts on the car until it comes to rest.

The car is modelled as a particle without any other external forces acting on it.

a) Find the time taken to bring the car to rest. **(4)**

b) Determine the distance the car covers from the instant the brakes were first applied until the car is brought to rest. **(3)**

Question 9

A car starts from rest at point A and accelerates at constant rate for 15 s reaching a speed of V ms^{-1}.

The car maintains this speed for 60 s. The car then decelerates at constant rate for 10 s, coming to rest at point B.

a) Given that the motion of the car takes place on a straight horizontal road, sketch for the motion of the car from A to B,

i. … a velocity time graph. **(3)**

ii. … an acceleration time graph. **(2)**

The distance AB is 1015 m.

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

Question 10

A beam AB has length 5.5 m and mass 20 kg.

The beam is smoothly supported at the point P, where $AP = 2$ m.

A man of mass 70 kg stands on the beam at A and another man stands on the beam at a distance of 2.5 m from B.

The beam is modelled as a non-uniform rod and the men are modelled as particles.

The beam is in equilibrium in a horizontal position with the reaction on the beam at P having a magnitude of 1960 N.

Calculate the distance of the centre of mass of the beam from A. **(6)**

Question 11

Relative to a fixed origin O, the horizontal unit vectors $\mathbf{i}$ and $\mathbf{j}$ are pointing due east and due north, respectively.

A particle P is moving with constant acceleration of $(-\mathbf{i}+\mathbf{j})$ ms^{-2}.

It is initially observed passing through the point with position vector $-2\mathbf{j}$ m with velocity of $2\mathbf{i}$ ms^{-1}.

a) Find the speed of P, 8 s after it was first observed. **(4)**

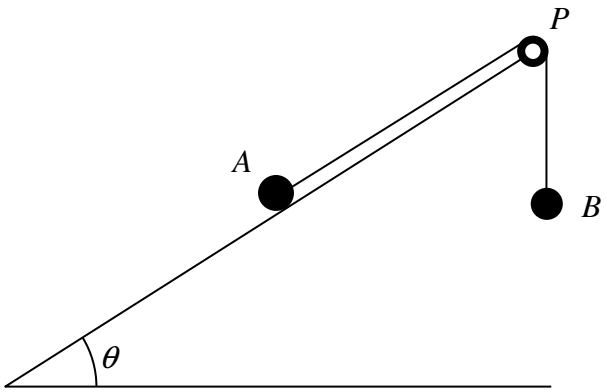
b) Calculate the distance of P from the origin, 8 s after it was first observed. **(4)**

Question 12

A particle is projected from horizontal ground, at some angle of elevation, and 3 s later is observed moving with speed 12 ms^{-1}, at an angle of $30°$ **below** the horizontal.

Determine the time for which the particle has a speed less than 12 ms^{-1}. **(8)**

Question 13



Two particles A and B, of equal mass are attached to each of the ends of a light inextensible string. The string passes over a smooth pulley P, at the top of a fixed rough plane, inclined at θ to the horizontal, where $\sin\theta = 0.28$.

Particle A is placed at rest on the incline plane while B is hanging freely at the end of the incline plane vertically below P, as shown in the figure above. The two particles, the pulley and the string lie in a vertical plane parallel to the line of greatest slope of the incline plane.

When the particles are released, A is at the point of slipping up the incline plane.

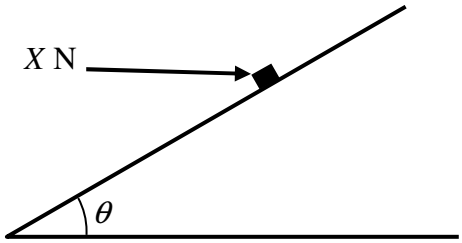
Find the value of the coefficient of friction between A and the plane. **(9)**

Question 14

Two forces $\mathbf{F}_1 = (2\mathbf{i} + 7\mathbf{j})$ N and $\mathbf{F}_2 = (4\mathbf{i} + k\mathbf{j})$ N, where k is a constant, act on a particle of mass m kg.

Find the value of m, given that the particle accelerates in the direction $3\mathbf{i} - 2\mathbf{j}$ with magnitude $5\sqrt{13}$ ms^{-2}. **(8)**

Question 15



A box of mass 2 kg, is pushed up a rough plane inclined at an angle θ to the horizontal, where $\tan\theta = \frac{3}{4}$, by a horizontal force X N, as shown in the above figure.

The force acts in a vertical plane, which contains the box and a line of greatest slope of the plane. The coefficient of friction between the box and the plane is $\frac{1}{2}$.

The box is accelerating up the plane at 1.45 ms^{-2}.

By modelling the box as a particle, find the value of X. **(9)**

Question 16

A particle is moving in a straight line.

At time t s, the particle has displacement x m from a fixed origin O and is moving with velocity $v \text{ ms}^{-1}$.

When $t = 1$, $x = -5$ and $v = 1$.

The acceleration a of the particle is given by

$$a = (16 - 6t) \text{ ms}^{-2}, \ t \geq 0.$$

The particle passes through O with speed U when $t = T$, $T > 0$.

Find the possible values of U. **(12)**
