IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper C

Difficulty Rating: 3.1100/0.6920

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 15 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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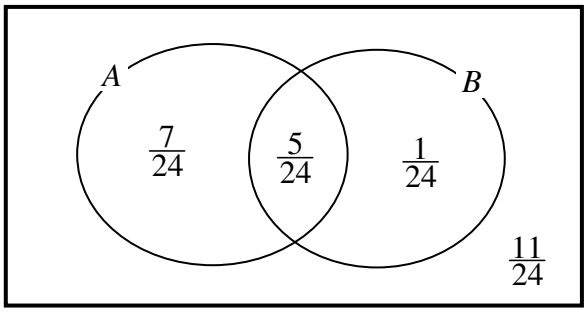
SECTION 1 - STATISTICS

Question 1



The figure above shows the probability sample space for two events A and B, summarized by a Venn diagram.

Determine the following probabilities.

a) At least one of the events A, B occurs. **(1)**

b) At most one of the events A, B occurs. **(1)**

c) Only event B occurs. **(1)**

d) Exactly one of the events A, B occurs. **(1)**

e) None of the events A, B occurs. **(1)**

f) Either both events occur or neither event occurs. **(1)**

g) Either event A occurs or neither event occurs. **(1)**

The word "or" in this question only implies one event or the other but not both.

Question 2

The table below shows the number of revolutions of a drill bit N, and the maximum temperature T °C reached by this drill bit after revolving for one minute.

N	600	700	900	1050	1300
T	49	47	52	52	53

a) State, with a reason, which is the explanatory variable in the above described scenario and state the statistical name of the other variable.

b) Use a statistical calculator to determine …

i. … the value of the product moment correlation coefficient between N and T. **(1)**

ii. … the equation of the regression line between T and N, giving the answer in the form

$$T = a + bN,$$

where a and b are constants. **(2)**

c) Interpret in the context of this question the physical meaning of a and b.

Comment further on the likely value of a in a real life scenario. **(3)**

d) Use the equation of the regression line to estimate the value of T when …

i. … $N = 1600$.

ii. … $N = 825$.

Comment further on the reliability of each of these estimates. **(4)**

Question 3

In a large university 39% of the students are female and the rest are male. A random sample of 80 students is selected from this university.

Use a distributional approximation, to find the probability that more than half the students in the sample are female. **(6)**

Question 4

The times taken to complete a 3 mile run, in minutes, by the members of a jogging club are summarized in the table below.

Times (nearest hour)	Frequency
11 – 14	24
15 – 17	24
18 – 19	19
20	11
21 – 23	21
24 – 28	15

a) Estimate the mean and standard deviation of this data.

Workings must be shown in this part. **(6)**

b) Estimate, by linear interpolation, the median of this data. **(2)**

c) Draw an **accurate** histogram to represent this data. **(4)**

d) Find the proportion of data which lies within 3 standard deviations of the mean. **(2)**

e) Discuss briefly whether this data could be modelled by a Normal distribution. **(3)**

Question 5

A test statistic has distribution $\mathrm{B}(40, p)$.

Given that

$$\mathrm{H}_0 : p = 0.2, \quad \mathrm{H}_1 : p \neq 0.2,$$

find the critical region for the test statistic at the 5% significance level. **(5)**

Question 6

Markus is a health fanatic.

On a given day, the probabilities that he goes for a run, he uses the gym or he cycles are 0.5, 0.4 and 0.1, respectively.

Markus sometimes uses the sauna after these activities.

The probability he uses the sauna after he goes for a run is 0.1. The respective probabilities for using the sauna after using the gym or cycling are 0.6 and 0.3.

Find the probability that on a given day Markus …

a) … will use the sauna. **(4)**

b) … used the gym, given he used the sauna. **(2)**

c) … did not go for a run, given he did not use the sauna. **(3)**

Question 7

The contents of bottles of olive oil, in ml, produced by a small factory are Normally distributed with mean μ and standard deviation 5.

a) Find the value of μ if 97.5% of these bottles contain more than 994 ml. **(4)**

b) Using the value of μ found in part **(a)**, determine the probability that a bottle picked at random will contain less than 992 ml. **(4)**

An inspector visits the factory and selects a bottle at random.

If the bottle contains less than 992 ml, the factory will get fined.

c) Given that the factory got fined, determine the probability that the bottle that the inspector examined contained less than 990 ml. **(5)**

Question 8

The discrete random variable X has the following probability distribution

x	0	1	3
$\mathrm{P}(X=x)$	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{2}$

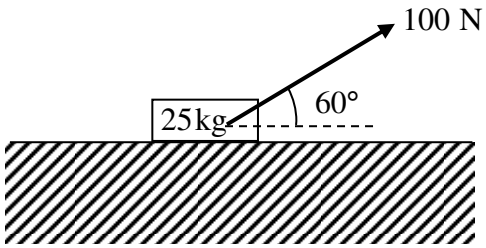
Two independent observations of X are made, denoted by X_1 and X_2.

a) Find the probability distribution of $X_1 + X_2$. **(5)**

b) Calculate $P(X_1 > X_2)$. **(3)**

SECTION 2 - MECHANICS

Question 9



The figure above shows a small box of mass 25 kg , pulled along rough horizontal ground by a light inextensible rope, which is inclined at $60°$ to the horizontal.

The force supplied by the rope is 100 N .

The box, which is modelled as a particle, is in limiting **equilibrium**.

Calculate the value of the coefficient of friction between the box and the ground. **(5)**

Question 10

A car is travelling along a straight horizontal road. At time $t = 0$ s it goes past a point A on this road with speed 16 ms^{-1}.

As the car passes A it begins decelerate uniformly reaching a speed of 10 ms^{-1} covering a distance of 104 m.

The car then immediately begins to accelerate uniformly for 12 s reaching a speed u ms^{-1}, where $u > 16$.

This new speed is maintained for another 32 s when the car goes past a point B on this road.

a) Sketch a speed time graph to show the motion of the car from A to B. **(3)**

b) Determine the total time taken for the car to move from A to B. **(3)**

The distance AB is 1 km.

c) Calculate the value of u. **(4)**

Question 11

A particle P is projected vertically upwards with speed 17.5 ms^{-1} from a point A, which is H m above level horizontal ground.

P moves freely under gravity until it hits the ground 5 s later, with speed V ms^{-1}.

a) Determine the value of H. **(4)**

A second particle Q is thrown vertically upwards with speed U ms^{-1} from A and moves freely under gravity until it hits the ground.

b) Given that Q hits the ground with speed $\frac{6}{7}V$ ms^{-1}, find the value of U. **(6)**

Question 12

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

A ship A is moving with constant velocity.

At noon A is at the point with position vector $(12\mathbf{i}+12\mathbf{j})$ km and at 2 p.m. it has sailed to the point with position vector $(8\mathbf{i}+20\mathbf{j})$ km.

a) Determine the velocity of A. **(3)**

b) Write down an expression for the position vector of A, t hours after noon. **(2)**

A ship B is also moving with constant velocity and its position vector, $\mathbf{r}$ km, t hours after noon is given by

$$\mathbf{r}=(2t+k)\mathbf{i}+(2t+33)\mathbf{j},$$

where k is a scalar constant.

c) Given that A intercepts B determine the value of k. **(3)**

Question 13

A particle P is moving on the x axis and its acceleration a ms^{-2}, t seconds after a given instant, is given by

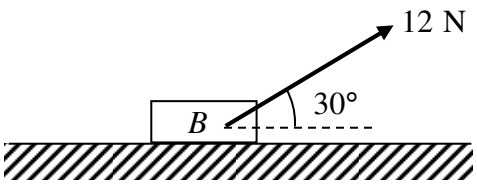
$$a=6t-18,\ t\geq 0.$$

The particle is initially at the origin O, moving with a speed of 15 ms^{-1} in the positive x direction.

a) Determine the times when P is instantaneously at rest. **(7)**

b) Find the distance between the points, at which P is instantaneously at rest. **(6)**

Question 14



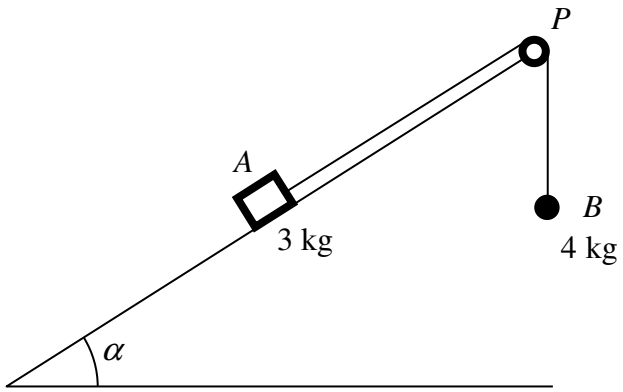
A box B of mass 1.25 kg is pulled along rough horizontal ground by a force of magnitude 12 N inclined at 30° to the horizontal, as shown in the figure above. The box is modelled as a particle moving on a rough horizontal plane where coefficient of friction between the particle and the plane is 0.25.

a) Determine the acceleration of the box. **(6)**

The pulling force is suddenly removed when the box has a speed of $7.35\ \text{ms}^{-1}$.

b) Find the time it takes the box to come to rest from the instant the pulling force was removed. **(6)**

Question 15



Two particles A and B, of mass 3 kg and 4 kg respectively, 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 α to the horizontal, where $\tan\alpha = 0.75$.

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.

The particles are released from rest with the string taut.

Particle A begins to move up the incline plane, where the constant ground friction between A and the plane has magnitude 10.5 N.

Ignoring air resistance, calculate ...

a) ... the acceleration of the system immediately after the particles are released. **(6)**

b) ... the magnitude and direction of the force exerted by the string on P. **(4)**

2 s after release, while both particles are moving, the string breaks.

c) Calculate the total distance A moves up the plane from the instant since the particles were released, assuming that A does not reach the pulley. **(7)**