IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper I

Difficulty Rating: 3.4467/0.7833

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.

SECTION 1 - STATISTICS

Question 1

Jane and Amber are telesales operatives for a company.

The probability of Jane making a sale on a customer call is 0.1.

a) Showing a clear method, find the probability that Jane achieves …

i. … no sales in 10 calls. **(2)**

ii. … more than 4 sales in 20 calls. **(2)**

The probability of Amber making a sale on a customer call is 0.15.

b) If Jane and Amber make 20 calls each, determine the probability that they will make

i. … 2 sales each. **(3)**

ii. … a total of 4 sales between them. **(5)**

c) Calculate the least number of calls that a Amber needs to make for the probability of at least 1 sale, to exceed 0.99. **(5)**

Question 2

It has been established over a long period of time, that in Enzo's Restaurant 30% of the orders are vegetarian.

Using a distributional approximation, find the probability that in a given day with 80 orders, there will be more than 30 vegetarian orders. **(6)**

Question 2

The diameters of fine sand particles, in mm, are summarised in the table below.

Diameters (d)	Frequency
$0.02 < d \leq 0.04$	25
$0.04 < d \leq 0.06$	76
$0.06 < d \leq 0.08$	111
$0.08 < d \leq 0.10$	255
$0.10 < d \leq 0.12$	33

a) By using the coding

$$y = 50(x - 0.09),$$

where x represents the midpoint of each class, estimate the mean and the standard deviation of this data.

The formulae for mean and standard deviation must be used in this part. **(6)**

b) Estimate, by linear interpolation, the median diameter of these sand particles. **(2)**

c) Describe, with justification, the skewness of the data. **(2)**

Question 4

The lifetimes, in hours of a certain make of light bulbs are assumed to be Normally distributed with a mean of 5500 hours and a standard deviation of 120.

a) Find the probability that the lifetime of a light bulb picked at random will exceed 5764 hours. **(4)**

b) Determine the lifetime **not** achieved by 0.4% of these light bulbs. **(4)**

Thirty of these light bulbs are selected.

c) Find the probability that two out of these thirty light bulbs will have a lifetime exceeding 5764 hours. **(3)**

Question 5

The events A and B satisfy

$$\mathrm{P}(A)=\frac{3}{5}, \qquad \mathrm{P}(B)=\frac{5}{8}, \qquad \mathrm{P}(A\cup B)=\frac{7}{10}.$$

a) Illustrate this information in a fully completed Venn diagram. **(3)**

b) Determine, showing all the relevant workings, whether A and B are statistically independent. **(2)**

The events A and C satisfy

$$\mathrm{P}(A\cup C)=\frac{7}{10} \qquad \text{and} \qquad \mathrm{P}(C|A)=\frac{1}{3}.$$

c) Determine …

i. $\mathrm{P}(A|C)$. **(5)**

ii. … $\mathrm{P}\left[(A\cap C)'\right]$. **(1)**

Question 6

The proportion of tiles with minor faults produced in a factory is thought to be 10%.

The factory manager believes that the proportion is higher due to the old machinery.

He inspects a random sample of 20 tiles.

a) Stating your hypotheses clearly, find the critical region to test the manager's belief, at the 5% level of significance. **(6)**

b) State the actual significance level for a test using the critical region of part **(a)**. **(1)**

Four faulty tiles were found in the sample.

c) Complete the test. **(2)**

Question 7

Arnie and Ned play each other in a darts match, which consists of **up to three** games.

The winner is the first person to win two games.

The probability that Arnie wins the first game is 0.7.

Whenever Arnie wins a game the probability he wins the next is 0.6.

Whenever Ned wins a game the probability he wins the next is 0.8.

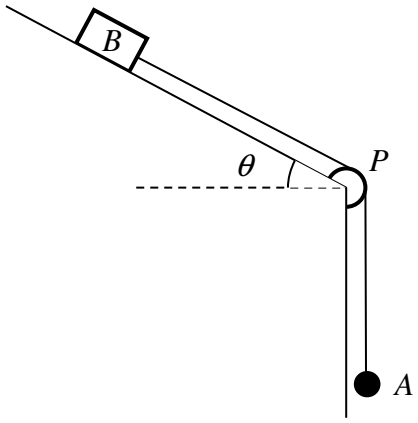
a) Find the probability that Arnie wins the match. **(6)**

b) Given that Arnie won the match find the probability he won in two games. **(2)**

c) Given Arnie won the first game find the probability he won the match. **(3)**

SECTION 2 – MECHANICS

Question 8



A particle A and a small box B , with respective masses of 3 kg and 7 kg , are attached to the ends of a light inextensible string.

B is held at rest on a rough plane inclined at θ to the horizontal, where $\tan\theta = \frac{3}{4}$.

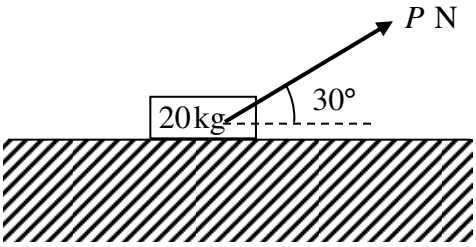
The coefficient of friction between the box and the plane is 0.6 .

The string lies along the plane and passes over a small smooth pulley P which is fixed at the bottom end of the plane.

A is hanging vertically below the end of the plane. The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in the figure above. B is released from rest with the string taut.

After release, determine the acceleration of the system and the tension in the string. **(9)**

Question 9



The figure above shows a small box of mass 20 kg, pulled along rough horizontal ground by a light inextensible rope, which is inclined at $30°$ to the horizontal.

The force supplied by the rope is P N.

The box, which is modelled as a particle, is at the point of slipping.

Given further that the coefficient of friction between the box and the ground is 0.25, calculate the value of P. **(9)**

Question 10

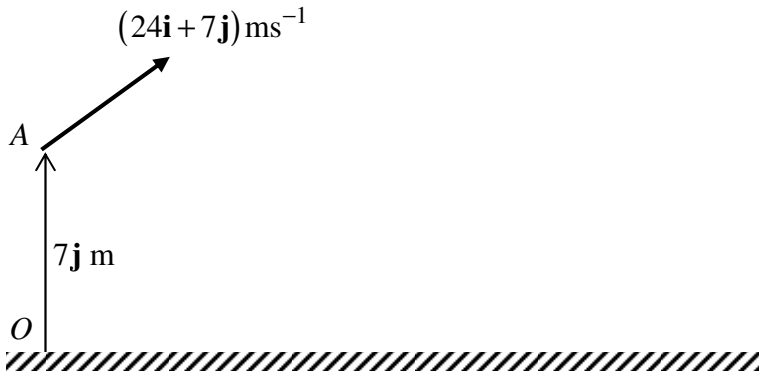
A particle is projected vertically upwards with speed 24 ms^{-1}, from a balcony which is located 2.5 m above level horizontal ground.

The particle is moving freely under gravity and strikes the ground T s later with speed v ms^{-1}.

a) Calculate the value of T. **(5)**

b) Determine the value of v. **(3)**

Question 11



A fixed origin O is located on level horizontal ground and the vectors $\mathbf{i}$ and $\mathbf{j}$ are unit vectors pointing horizontally and vertically, respectively.

A particle P is projected from the point A with position vector $7\mathbf{j}$ m with velocity $(24\mathbf{i}+7\mathbf{j})$ ms^{-1}, as shown in the figure above.

In the subsequent motion the particle is moving freely under gravity.

a) Find the length of time for which P is at least 9.1 m above the ground. **(6)**

P is passing through the point with position vector $(48\mathbf{i}+\lambda\mathbf{j})$ m.

b) Determine the value of λ. **(4)**

Question 12 **(**)**

A particle P is moving on the x axis and its displacement from the origin, x m, t seconds after a given instant, is given by

$$x=\tfrac{1}{3}t\left(t^2-3t-24\right),\ t\geq 0.$$

Determine the displacement of P when it is instantaneously at rest. **(5)**

Question 13

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

A small unmanned boat is drifting in the sea with **constant** velocity.

At 10.00 a.m. it is observed at the point with position vector $(-2\mathbf{i}+3\mathbf{j})$ km and at 10.45 a.m. it has drifted to the point with position vector $(-5\mathbf{i}+3.75\mathbf{j})$ km.

The position vector of the boat, t hours after 10.00 a.m., is $\mathbf{b}$ km.

a) Find an expression for $\mathbf{b}$ in terms of t. **(5)**

At 11.30 a.m. a patrol boat leaves from the point with position vector $(2\mathbf{i}+\mathbf{j})$ km and intercepts the small unmanned boat at 11.45 a.m. The patrol boat is moving with **constant** velocity, $\mathbf{V}$ km h^{-1}.

b) Find $\mathbf{V}$, giving the answer in the form $a\mathbf{i}+b\mathbf{j}$, where a and b are constants to be found. **(5)**

Question 14

A car is travelling on a straight horizontal road, starting from rest from a set of traffic lights at A, accelerating uniformly to a speed 20 ms^{-1}, in 30 s.

The car maintains this speed for 74 s when it uniformly decelerates at 1.25 ms^{-2}, coming to rest at the next set of traffic lights at B.

a) Sketch a speed time graph for the motion of the car between A and B. **(2)**

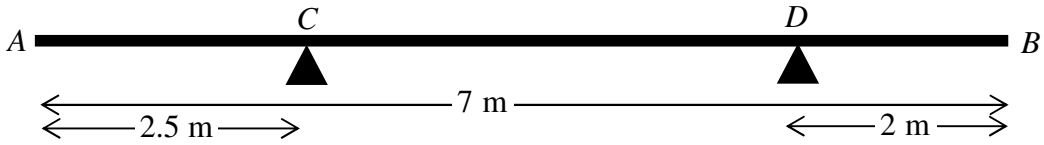
b) Find the distance from A to B. **(3)**

A motorcycle leaves A, 3.5 s after the car left A.

The motorcycle is accelerating uniformly at a ms^{-2} overtaking the car at the point M, where M is the midpoint of AB.

c) Determine the value of a, correct to three significant figures. **(7)**

Question 15



A non uniform rod AB has length 7 m and weight 300 N. The centre of mass of the rod is x m from A.

The rod is placed on two smooth supports at C and D, where $AC = 2.5$ m and $DB = 2$ m. The supports at C and D are at the same horizontal level, as shown in the figure above.

When a particle of weight W N is placed on the rod at A the reaction force on the rod at C is 200 N. The rod and the particle rest in equilibrium, with AB in a horizontal position.

a) Show clearly that

$$200 = 60x - W .$$ **(5)**

The particle is then removed from A and placed on the rod at B. The rod and the particle remain in equilibrium, with AB in a horizontal position and the reaction force on the rod at C is now 80 N.

b) Calculate the value of W and the value of x. **(7)**