IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper D

Difficulty Rating: 3.4333/0.7992

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 17 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

In a histogram the weights of peaches, correct to the nearest gram, are plotted on the x axis.

In this histogram the class $146-150$ has a frequency of 75 and is represented by a rectangle of base 2.8 cm and height 7.5 cm.

In the same histogram a different class is represented by a rectangle of base 5.6 cm and height 10.5 cm.

Determine the frequency of this class. **(4)**

Question 2

The continuous random variable Y is Normally distributed with a mean of 122 and a standard deviation of 14.

a) Find $\mathrm{P}(125 < Y < 139)$. **(4)**

b) Determine the value of a such that $\mathrm{P}(101 < Y < a) = 0.8276$ **(6)**

Question 3

The events A and B satisfy

$$\mathrm{P}(A) = 0.4 \qquad \text{and} \qquad \mathrm{P}(A \cup B) = 0.79 .$$

Determine $\mathrm{P}(B)$ in each of the two following cases.

a) If A and B are mutually exclusive. **(2)**

b) If A and B are independent. **(3)**

Question 4

The ages of the residents of Arnold Street are denoted by x the ages of the residents of Benedict Street are denoted by y.

These are summarized in the following back to back stem and leaf diagram.

x		y
5	0	
5,5,3,3	1	
9,9,1	2	5
9,8,6,5,5,4,3,2,2,2,1	3	6,7,8
6,4,1,0,0,0,0	4	1,2,2,3,4,8
9	5	1,4,4,4,4,5,8,8
	6	1,3,4,4,5,9,9
	7	2,6,9

where $\overline{2}|\overline{3}|\overline{9} = 32$ in Arnold Street and 39 in Benedict Street.

a) Find separately for the residents of Arnold Street and Benedict Street, ...

i. ... the mode.

ii. ... the lower quartile, the median and the upper quartile.

iii. ... the mean and the standard deviation. **(10)**

You may assume $\sum x = 866$, $\sum x^2 = 31514$, $\sum y = 1516$, $\sum y^2 = 86880$.

A coefficient of skewness is defined as

$$\frac{\text{mean} - \text{mode}}{\text{standard deviation}}.$$

b) Evaluate this coefficient for the ages in each street. **(1)**

c) Compare the distribution of the ages between the two streets. **(3)**

Question 5 **(**)**

The percentage test exam marks, of a random sample of 8 students, in Physics and Chemistry are recorded in the table below.

Student	A	B	C	D	E	F	G	H
Physics	70	36	56	56	58	45	67	72
Chemistry	78	49	55	50	75	50	60	57

Test, at the 5% level of significance, whether there is evidence of positive correlation between the percentage test marks in Physics and Chemistry. **(5)**

Question 6

Taxis in Pajan have to pass an additional safety test consisting of three parts, one for the brakes, one for the tyres and one for the lights. A taxi must pass all three parts.

The individual probabilities that a taxi will fail the "brake part", the "tyre part" and the "light part" are $\frac{1}{6}$, $\frac{1}{4}$ and $\frac{1}{5}$, respectively.

These probabilities are independent of one another.

A taxi from Pajan is tested at random.

a) Find the probability that it will fail **exactly one** of the three parts of the test. **(4)**

Safety regulations change so that the test has to be performed in the order "brake part" first, "tyre part" next and "lights part" last.

If the taxi fails one of the three parts the test results in failure, **without** any of remaining parts of the test having to be carried out.

A taxi from Pajan is tested at random under these new regulations.

b) Find the probability that it will fail the test. **(4)**

c) Given a taxi failed the test, determine the probability it failed the "lights part". **(3)**

Question 7

The discrete random variable X has the following probability distribution

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

Three independent observations of X are made, denoted by X_1, X_2 and X_3.

Calculate $P(X_1+X_2+X_3 \geq 4)$. **(7)**

Question 8

It has been established over a long period of time that in a particular variety of rose bushes, 0.2 produce pink flowers.

A selection of 10 rose bushes of this variety, are bought.

a) Find probability that more than 4 of these bushes will produce red flowers. **(2)**

b) Calculate the least number of rose bushes that need to be bought so that the probability of producing at least 1 plant with pink flowers exceeds 0.975. **(4)**

Another selection of 125 rose bushes of this variety are bought.

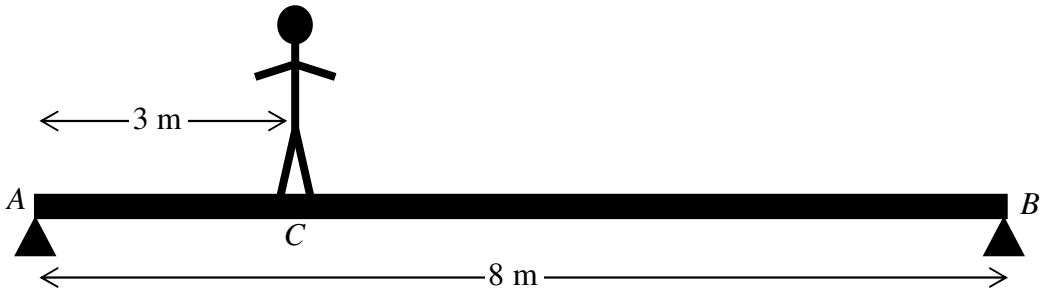
c) **Use a Normal distribution approximation** to determine the probability that the number of bushes which will produce pink flowers will be more than 21 but no more than 30. **(7)**

Finally a selection of 25 rose bushes of the same variety are considered. When these rose bushes flowered they produced 10 plants with pink flowers.

d) Stating your hypotheses clearly, test at the 1% level of significance, whether this constitutes evidence that this variety of rose bushes have a higher probability than 0.2 in producing pink flowers. **(6)**

SECTION 2 - MECHANICS

Question 9



A non uniform plank of wood AB has length 8 m and mass 100 kg.

The plank is smoothly supported at its two ends A and B. A boy of mass 60 kg stands on the plank at the point C, where $AC = 3$ m, as shown in the figure above.

The plank with the boy standing on the plank, remains in equilibrium with AB horizontal. The plank is modelled as a non uniform rod and the boy as a particle.

a) Given that the reactions at the two supports are equal, determine the distance of the centre of mass of the plank from A. **(4)**

b) Explain in the context of this problem the model of

i. … the plank is a rod **(1)**

ii. … the boy is a particle. **(1)**

Question 10

A lift is moving upwards.

The lift accelerates from rest with uniform acceleration $0.36\ \text{ms}^{-2}$ until it reaches a speed of $1.62\ \text{ms}^{-1}$.

It then travels at constant speed for $15\ \text{s}$ before decelerating uniformly to rest in $6.5\ \text{s}$.

a) Sketch a speed time graph for the lift's journey. **(2)**

b) Determine the distance covered by the lift during the journey. **(4)**

A man of mass $80\ \text{kg}$ is standing in the lift during this journey.

c) Calculate the greatest value of the reaction exerted by the floor of the lift on the man during the journey. **(2)**

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 $\left(\frac{1}{10}\mathbf{i}-\frac{1}{5}\mathbf{j}\right)\ \text{ms}^{-2}$.

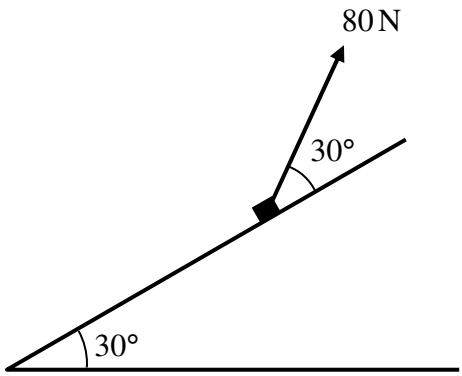
It is initially observed passing through the point with position vector $\left(-20\mathbf{i}-\frac{15}{2}\mathbf{j}\right)\ \text{m}$ with velocity of $\left(4\mathbf{i}+2\mathbf{j}\right)\ \text{ms}^{-1}$.

a) Find an expression for the position vector of P, t s after it was first observed. **(2)**

b) Calculate the times when P is due east of the origin O. **(4)**

c) Determine the speed of P when it is travelling in a south-eastern direction. **(6)**

Question 12



A box of mass 10 kg is pulled by a rope on a fixed rough inclined plane. The rope is modelled as a light inextensible string and the box is modelled as a particle. The plane is at an angle of $30°$ 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 at $30°$ to the plane. When the tension in the rope is 80 N the box is travelling up the plane, at constant speed.

The normal reaction between the box and the plane is R N.

Given that the magnitude of the friction between the box and the plane is μR, where μ is a positive constant, determine the value of μ. **(7)**

Question 13

A particle is projected from a point O with speed 36 ms^{-1} at an angle of elevation β.

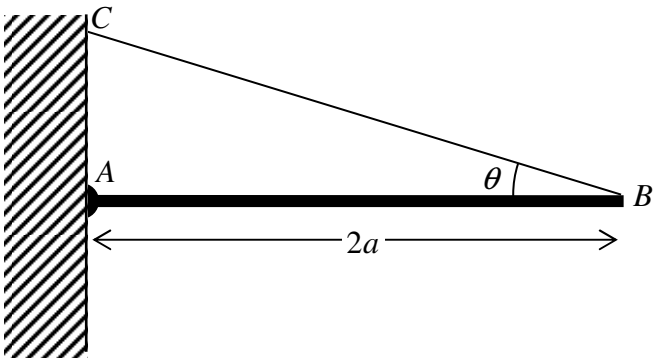
It reaches a point P which is at the same vertical level as O and at a horizontal distance of 60 m from O.

The particle is subject to no other external forces except its weight.

a) Find the two possible values of β. **(8)**

b) Determine the shortest possible flight time for the journey. **(2)**

Question 14



The figure above shows a uniform rod AB of length $2a$ and of mass m smoothly hinged at the point A, which lies on a vertical wall.

The rod is kept in a horizontal position by a light inextensible string BC, where C lies on the same wall vertically above A.

The plane ABC is perpendicular to the wall and the angle ABC is denoted by θ.

Given that $\tan\theta = \frac{1}{2}$, show that …

a) … the tension in the string is $\frac{1}{2}\sqrt{5}mg$. **(3)**

b) … the magnitude of the reaction at the hinge has the same magnitude as the tension in the string. **(5)**

Question 15

A car is travelling along a straight horizontal road with constant acceleration a ms^{-2}.

The points A, B and C lie in that order on this road.

The car is passing through A with speed 11 ms^{-1}, through B with speed 17 ms^{-1}, and through C with speed 29 ms^{-1}.

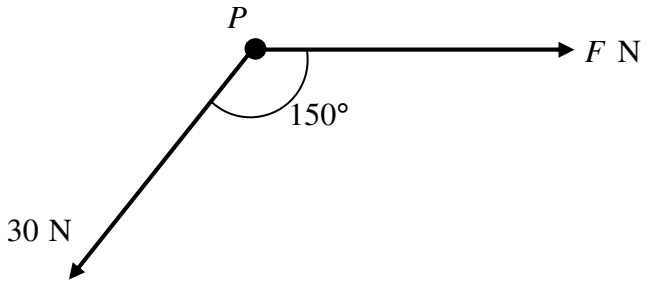
The distance $AB = 28$ m.

By modelling the car as a particle calculate in any order …

a) … the distance AC **(4)**

b) … the time it takes the car to travel from A to C. **(2)**

Question 16



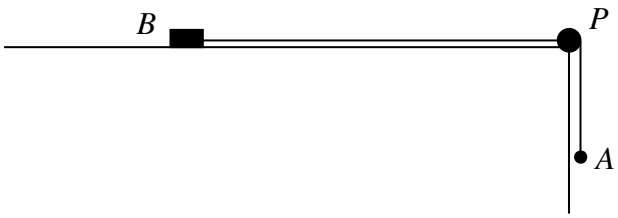
Two forces, act on a particle P so that the angle between the two forces is 150°.

The magnitude of one of these forces is 30 N and the magnitude of the other force is F N, as shown in the figure above.

The resultant of these two forces has magnitude R N, and acts at 60° to the force with magnitude F N.

Calculate in any order the value of R and the value of F. **(6)**

Question 17



A particle A of mass 5 kg is connected to small box B of mass 7.5 kg by a light inextensible string. The string passes over a light smooth pulley P, which is located at the end of a rough horizontal house roof. The box is held on the roof with the particle hanging vertically at the end of the roof, as shown in the figure above.

The system is released from rest with the string taut.

The string, A, P and B lie in a vertical plane at right angles to the end of the roof.

a) Given that the coefficient of friction between B and the roof is 0.2, find in any order…

i. … the acceleration of the system.

ii. … the tension in the string. **(5)**

On release B is at a distance d m from P. When A has moved a distance of 2.8 m the string breaks. In the subsequent motion B comes to rest as it reaches P.

b) Calculate the value of d. **(7)**