IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper K

Difficulty Rating: 3.0133/0.6696

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 18 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

Weight in kg (w)	Frequency
$1 \leq w < 3$	15
$3 \leq w < 5$	31
$5 \leq w < 6$	45
$6 \leq w < 6.5$	37
$6.5 \leq w < 7$	21
$7 \leq w < 10$	15

The weights, in kg, of the 164 bags packed by supermarket customers is summarized in the table above.

a) Estimate the mean and the standard deviation of these weights. **(5)**

b) Estimate, by linear interpolation, the median value and hence determine with justification, the skewness of the data. **(4)**

In a histogram drawn for the above data, the $1 \leq w < 3$ class is represented by a rectangle of base length 2.4 cm and height 2.5 cm.

c) Find the base length and height of the rectangle representing the $6.5 \leq w < 7$ class in the same histogram. **(3)**

It is further given that the lower and upper quartiles of these distances are 4.68 and 6.43, respectively.

d) Investigate the possibility of any outliers. **(3)**

e) Discuss briefly whether the above set of data can be modelled by a normal distribution. **(1)**

Question 2

The table below shows the daily number of shoplifting incidents in a shopping mall, for a given seven day week and the number of the security guards employed in each of these seven days.

Number of Shoplifting Incidents	17	20	23	11	35	32	21
Number of Security Guards Employed	6	6	5	7	4	3	5

a) Find, using a statistical calculator, the value of the product moment correlation coefficient for these data. **(1)**

b) Test, at the 1% level of significance, whether there is evidence of correlation in these bivariate data. **(4)**

c) Briefly comment on the statement:

"… Increasing the number of security guards will result in a decrease in the shoplifting incidents …" **(2)**

Question 3

A sixth form class consists of 6 boys and 4 girls.

Three students are selected at random from this class and the variable X represents the number of girls selected.

Show that the probability distribution of X is given by

x	0	1	2	3
$\mathrm{P}(X = x)$	$\frac{5}{30}$	$\frac{15}{30}$	$\frac{9}{30}$	$\frac{1}{30}$

(5)

Question 4

Explain the statistical term of random sampling and give an example of such method, describing the process briefly in context. **(4)**

Question 5

When people are asked "what is your favourite day of the week?", it is thought that on average one person in four replies "Sunday".

To test this assertion 15 people were asked this question and 7 replied "Sunday".

Carry out a significance test, at the 5% level, of whether the statement "on average the preferred day of the week is Sunday, for one in four persons". **(7)**

Question 6

Of the workforce of a factory 22.5% live within 30 miles of the factory.

A random sample of 40 workers is selected.

Use a distributional approximation to show that the probability, of more than 5 workers in this sample live within 30 miles of the factory, is 0.907 . **(7)**

Question 7

The weights of packs of cheese, in grams, are thought to be Normally distributed with a standard deviation of 4 .

a) Find the mean weight of a pack of cheese, if 95.5% of these packs are heavier than 248 grams.

Give the answer correct to the nearest gram. **(4)**

Using the value of the mean obtained in part **(a)**, ...

b) ... determine the probability that a randomly chosen pack of cheese weighs between 250 and 256 grams. **(4)**

c) ... determine the probability that given a randomly chosen pack of cheese weighs more than 248 grams then its actual weight is less than 256 grams. **(4)**

Ten packs of cheese are selected at random.

d) Calculate, correct to 3 significant figures, the probability that exactly 6 of these packs weigh over 248 grams. **(3)**

Question 8

In the Southgate Academy Sixth Form the students are either left handed or right handed. The following information is also known.

- 0.6 of the students are female.
- 0.11 of the students are left handed.
- 0.10 of the female students are left handed.

a) Draw a fully completed Venn Diagram to display the above information. **(4)**

A single student is selected at random from the Southgate Academy Sixth Form.

b) Determine the probability that the student is female and right handed. **(1)**

c) Given that the student is left handed, determine the probability that the student is female. **(2)**

d) Given that the student is male, determine the probability that the student is left handed. **(2)**

Question 9

General purpose hooks are sold in boxes of 50.

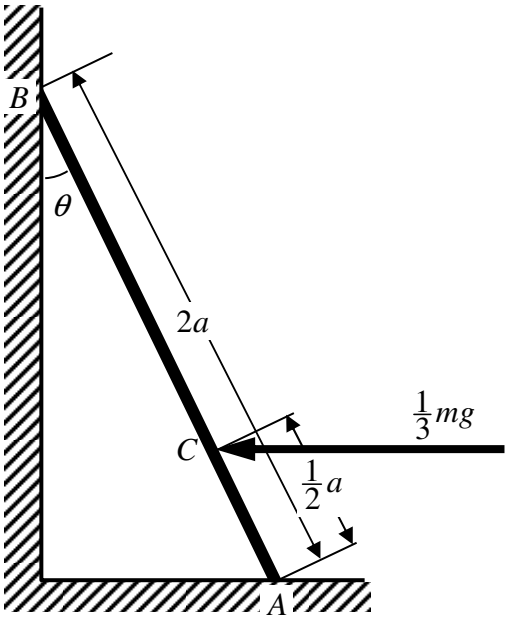
The probability that a hook will be defective is 0.05.

10 boxes of hooks are examined.

Determine, to 2 significant figures, the probability that half of these boxes will contain more than 5 defective hooks each. **(5)**

SECTION 2 - MECHANICS

Question 10



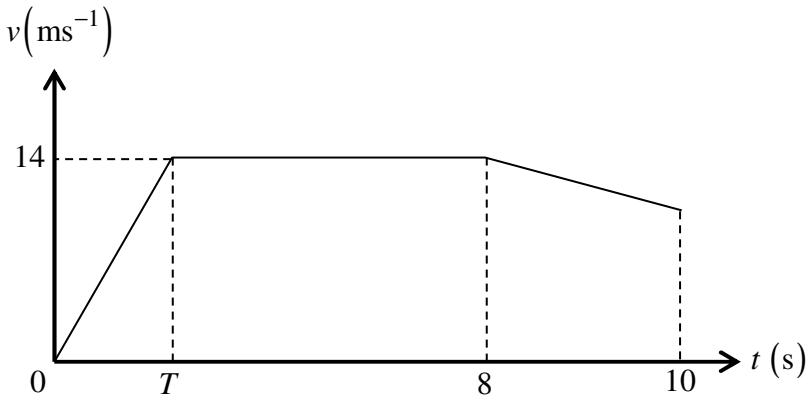
A ladder of length $2a$ and mass m, has one end A on smooth horizontal ground and the other end B against a smooth vertical wall.

The ladder is kept in equilibrium by a horizontal force of magnitude $\frac{1}{3}mg$ acting at a point C on the ladder, where $AC = \frac{1}{2}a$, as shown in the figure above.

The angle between the ladder and the vertical wall is θ.

By modelling the ladder as a uniform rod show that $\tan\theta = \frac{1}{2}$. **(7)**

Question 11



The figure above shows the velocity time graph (t, v) of a sprinter running a 100 m race in a straight horizontal track.

The sprinter starts from rest and accelerates uniformly until he reaches a speed of $14\ \text{ms}^{-1}$, when $t = T$ s. He then maintains his speed until $t = 8$ s. The sprinter then decelerates uniformly at $0.5\ \text{ms}^{-2}$ until he finishes the race when $t = 10$.

a) Show by calculation that $T = 5\frac{4}{7}$. **(6)**

b) Determine the acceleration of the sprinter at the start of the race. **(2)**

Question 12

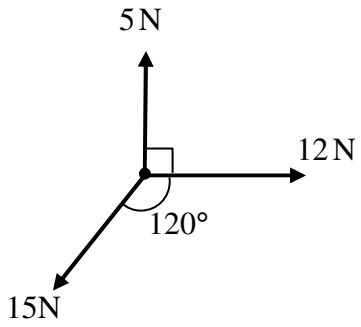
A particle is projected vertically upwards with speed $29\ \text{ms}^{-1}$, from a balcony which is h m above level horizontal ground.

The particle is moving freely under gravity and strikes the ground 6 s later with speed $v\ \text{ms}^{-1}$.

a) Calculate the value of h. **(3)**

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

Question 13



The figure above shows three forces which lie on the same plane, acting on a particle.

The magnitudes of these forces and their relative directions are shown in the figure.

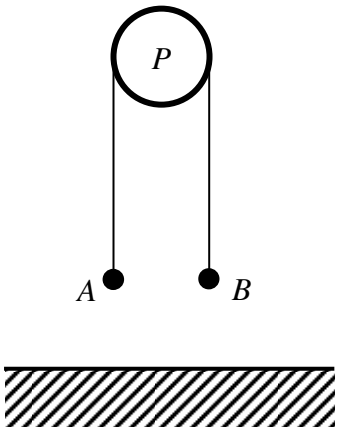
a) Find the magnitude of the resultant of the above three forces. **(5)**

b) Find the angle the resultant makes with the 5 N force. **(3)**

The direction in which these three forces act can be changed.

c) State, with full justification, the least and the greatest magnitudes of the resultant force. **(3)**

Question 14



Two particles A and B of respective masses 5 kg and 9 kg are each attached to the two ends of a light inextensible string which passes over a smooth pulley P.

The two particles are both held at rest, 1.75 m above a horizontal floor with the portions of the strings, not in contact with the pulley, vertical.

The system is then released from rest.

When in motion, each particle is subject to a constant air resistance of 3.5 N.

In the resulting motion B reaches the floor before A reaches P.

a) Calculate the tension in the string, for the period before B reaches the floor. **(6)**

b) Determine the speed with which B strikes the floor. **(2)**

Question 15

A particle is projected from a point O on level horizontal ground with speed of $28\ \text{ms}^{-1}$ at an angle α to the horizontal, where $\tan\alpha = \frac{3}{4}$.

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

a) Find the time it takes the particle to reach the greatest height above the ground. **(3)**

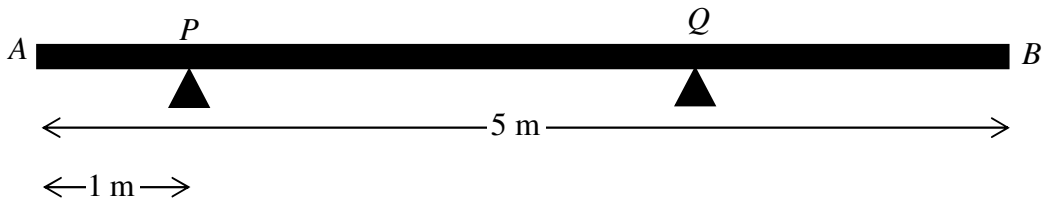
b) Hence determine the distance OP. **(3)**

The particle reaches a height H m above ground, 1 second after leaving O.

c) Find the value of H. **(2)**

d) Hence calculate the length of time for which the height of the particle above the ground is greater than H. **(3)**

Question 16



A uniform rod AB has length 5 m and weight 100 N.

The rod rests in a horizontal position on two smooth supports at P and Q, where $AP = 1$ m, as shown in the figure above.

The magnitude of the reaction force on the rod at P is 40 N.

a) Determine the magnitude of the reaction force on the rod at Q. **(1)**

b) Calculate the distance AQ. **(3)**

Question 17

A particle P is moving on the x axis and its velocity v ms^{-1}, t s after a given instant, is given by

$$v = t^2(3-t),\ t \geq 0.$$

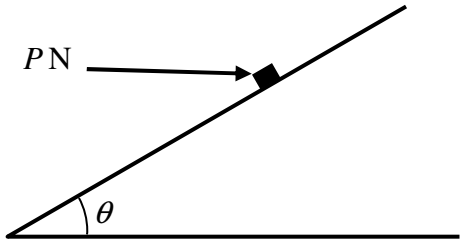
When $t = 2$, P is observed to be 4 m from the origin O, in the positive x direction.

a) Find the acceleration of P when $t = 2$. **(3)**

The particle is at instantaneous rest initially, and when $t = T$.

b) Determine the distance of P from O when $t = T$. **(9)**

Question 18



The figure above shows a box of mass 120 kg, resting in limiting equilibrium, on a rough plane inclined at an angle θ to the horizontal, where $\tan\theta = \frac{4}{3}$.

A **horizonta**l force P N, pushes the box so that the box is at the point of slipping up the plane. The coefficient of friction between the box and the plane is $\frac{2}{3}$.

By modelling the box as a particle, find the value of P. **(8)**