## ZIMBABWE SCHOOL EXAMINATIONS COUNCIL General Certificate of Education Ordinary Level

## ADDITIONAL MATHEMATICS

 4026/2PAPER 2
SPECIMEN PAPER
2 hours 30 minutes
Additional materials:
Answer paper
Mathematical tables
Graph paper
Formula Booklet

TIME 2 hours 30 minutes

## INSTRUCTIONS TO CANDIDATES

Write your Name, Centre number and Candidate number in the spaces at the top of answer paper or answer booklet provided.
Answer all questions in Section A and any five questions from Section B and Section C.
Do not answer more than four questions in Section $\mathbf{B}$ and not more than four questions in
Section C.
All working must be shown clearly.
Where necessary take $\mathrm{g}=10 \mathrm{~ms}^{-2}$.
Electronic calculators may be used.

## INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question. If the degree of accuracy is not specified in the question and if the answer is not exact, the answer should be given to three significant figures. Answers in degrees should be given to one decimal place.

This question paper consists of $\mathbf{1 3}$ printed pages and $\mathbf{3}$ blank pages.
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## Section A [40 marks]

## Mechanics and Statistics

## Answer all questions in this section

1 (a) The time taken by nine athletes to complete a 100 metre race to the nearest second) was recorded. The results were as follows:
$13 ; 14 ; 11 ; 19 ; 120 ; 12 ; 14 ; 16 ; 18 ;$

Calculate the
(i) mean,
(ii) standard deviation of the data.
(b) Table 1.1 shows the distances that 100 people travelled to a popular shopping mall.

Table 1.1

| Distance (d km) | Frequency |
| :---: | :---: |
| $0 \leq \mathrm{d}<5$ | 5 |
| $5 \leq \mathrm{d}<10$ | 25 |
| $10 \leq \mathrm{d}<15$ | 28 |
| $15 \leq \mathrm{d}<20$ | 23 |
| $20 \leq \mathrm{d}<25$ | 17 |
| $25 \leq \mathrm{d}<30$ | 2 |

(i) Complete the cumulative frequency table for the information in Table 1.1 by finding the values of $a$ and $b$.

| distance <br> (km) | $\leq 5$ | $\leq 10$ | $\leq 15$ | $\leq 20$ | $\leq 25$ | $\leq 30$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| cumulative <br> frequency | 5 | 30 | $a$ | 81 | $b$ | 100 |

(ii) Using 2 cm to represent 5 km on the horizontal axis and 2 cm to represent 10 people on the vertical axis, draw a cumulative frequency graph using the information from the table in (i).

2 (a) A sprinter runs along a straight road passing through points A and B with speed $9 \mathrm{~ms}^{-1}$ and $13 \mathrm{~ms}^{-1}$, respectively. The sprinter's acceleration between points $A$ and $B$ is constant and equal to $0,4 \mathrm{~ms}^{-2}$.

Find the
(i) time taken by the sprinter to travel from point A to B .
(ii) distance AB .
(b) The velocity-time graph in Fig. 2.1 shows the motion of a particle for a fifteen seconds interval.


Fig. 2.1
Calculate the
(i) acceleration during the first 4 seconds,
(ii) total distance travelled during the 15 seconds,
(iii) average speed of the particle in $\mathrm{km} / \mathrm{h}$.

3 (a) Table 3.1 shows the number of candidates who passed with grade A in Mathematics, English and Science in a class.

Table 3.1

| Subject | Mathematics | English Language | Science |
| :---: | :---: | :---: | :---: |
| number of students | 30 | 50 | 40 |

(i) Calculate the size of angles that represent each subject on a pie chart.
(ii) Using a radius of 4 cm , draw a pie chart to illustrate the data in Table 3.1
(b) Table 3.2 shows the distribution of marks in a test taken by 30 students.

Table 3.2

| mark | $1-5$ | $6-10$ | $11-15$ | $16-20$ | $21-25$ |
| :--- | :---: | :---: | :---: | :---: | :---: |
| frequency | 4 | 6 | 11 | 6 | 3 |

(i) Calculate the mean mark.
(ii) Find the mode and the median of the data.

4 (a) A particle moves in a straight line. Its distance, $t$ seconds after leaving a fixed point A, is $x$ metres, where $x=\frac{1}{2} t^{2}+\frac{1}{15} t^{3}$.

Find the
(i) velocity after 5 seconds,
(ii) acceleration after 5 seconds.

## 5

4
(b)


Fig. 4.1

Three coplanar forces act at a point. The magnitudes of the forces are $6 \mathbf{N}, 7 \mathbf{N}$ and $8 \mathbf{N}$, and the directions in which the forces act are shown in Fig. 4.1.

Find the magnitude and direction of the resultant of the three forces.

## 6

## Section B: Mechanics

Answer not more than four questions in this section.

## Each question carries 12 marks

(a) A box of mass 500 kg is lifted vertically at a constant speed, by a cable of a crane.

Find the
(i) tension in the cable,
(ii) power applied to the box in increasing the height by 30 m in 50 seconds.
(b) Particles A and B of masses $0,5 \mathrm{~kg}$ and $0,2 \mathrm{~kg}$ respectively are attached to the ends of a light inextensible string. Particle A is held at rest on a horizontal table with the string passing over a smooth pulley at the edge of the table. Particle B hangs vertically below the pulley as shown in Fig. 5.1.


Fig. 5.1

The system is then released from rest. In the subsequent motion a constant frictional force of magnitude $0,6 \mathbf{N}$ acts on particle A.

Find the
(i) tension in the string
(ii) speed of particle $\mathrm{B}, 1,5$ seconds after it starts to move.

6 (a) A girl runs from point $X$ to a point $Z$. She stops at point $Z$ and then walks back towards point $X$ until she reaches a point $Y$, where she stops.
Fig. 6.1 shows the $v-t$ graph where $\mathrm{v} \mathrm{m} / \mathrm{s}$ is the girl's velocity at time $t$ and walks in the same straight line throughout.


Fig. 6.1
(i) Find the distance $X Y$ and $X Z$.
(ii) Sketch the graph of $x$ against $t$ where $x$ metres is the girl's distance from X. Show clearly the values of $t$ and $x$ when the girl arrives at Z , when she leaves Z and when she arrives at Y .

## 8

(b) The three coplanar forces shown in Fig.6.2 act at a point $\mathbf{A}$ and are in equilibrium.


Fig.6.2
Find the values of F and $\propto$.

## 9

7 (a) In Fig. 7.1 particles P and Q of masses 3 kg and 2 kg , respectively, are attached at the ends of a light inextensible string which passes over a smooth fixed pulley. Particle Q is held on the horizontal floor and particle P hangs freely. Particle Q is then released and the particles start to move vertically with constant acceleration of magnitude $a$ $\mathrm{m} / \mathrm{s}^{2}$.


Fig. 7.1
(i) Find the value of $a$.
(ii) Particle P hits the floor, 12 seconds after it starts to move and does not rebound upwards.

Show that P hits the floor with a speed of $24 \mathrm{~m} / \mathrm{s}$.
(iii) Find the gain in gravitational potential energy by particle Q , from the time it leaves the floor until it reaches its greatest height.
(b) A car travels on a horizontal straight road with a constant acceleration of $a \mathrm{~m} / \mathrm{s}^{2}$.

Given that the car increases speed from $20 \mathrm{~m} / \mathrm{s}$ to $40 \mathrm{~m} / \mathrm{s}$ over a distance of 750 m , find the value of $a$.

8 (a) A block of mass 6 kg sliding down a line of greatest slope of a plane inclined at $10^{\circ}$ to the horizontal. The co-efficient of friction between the block and the plane is 0.3 .
(i) Find the deceleration of the block.
(ii) Given that the initial speed of the block is $3 \mathrm{~m} / \mathrm{s}$, find how far the block travels.

## 10

8 (b) Two particles M and N are projected vertically upwards from horizontal ground at the same time. The speed of the projection of M and N are $15 \mathrm{~m} / \mathrm{s}$ and $9 \mathrm{~m} / \mathrm{s}$, respectively. The height of M and N above the ground, $t$, seconds after projection, are $h_{1} \mathrm{~m}$ and $h_{2} \mathrm{~m}$ respectively. Both particles come to rest after returning to the ground.
(i) Find the set of values of $t$ for which the particles are travelling in opposite directions.
(ii) At a certain instant, M and N are above the ground and $2 h_{1}=5 h_{2}$.

Find the velocities of M and N at this instant.

9 (a) Two bodies each of mass 500 kg collide head on when their speeds are $10 \mathrm{~m} / \mathrm{s}$ and $5 \mathrm{~m} / \mathrm{s}$.

If they stick together on impact, find
(i) their combined speed.
(ii) the loss in kinetic energy
(b) (i) A constant force acts in the direction of motion of a body of mass 3 kg . The force causes the body to increase speed from $5 \mathrm{~m} / \mathrm{s}$ to $15 \mathrm{~m} / \mathrm{s}$ in 3 seconds.

Find the constant force.
(ii) A tennis ball of mass $0,3 \mathrm{~kg}$ strikes a wall with a speed of $12 \mathrm{~m} / \mathrm{s}$. If the tennis ball bounces away from the wall with a speed of $9 \mathrm{~m} / \mathrm{s}$, find the impulse exerted on the ball.

## 11

## Section C: Statistics

Answer not more than four questions in this section.

## Each question carries $\mathbf{1 2}$ marks.

10 (a) A box contains 6 blue pens and 3 red pens. All pens are identical except for colour.

Two pens are drawn from the box one after the other, without replacement.
(i) Draw a tree diagram to show the outcomes of the experiment.
(ii) Find the probability that the pens drawn

1. are of the same colour,
2. include at least one blue pen.

10 (b) Events A and B are such that $\mathrm{P}(\mathrm{A})=0,2, \mathrm{P}(\mathrm{B})=0,6$ and $\mathrm{P}(\mathrm{A}$ and B$)=0,4$.

State, giving a reason in each case, whether events A and B are
(i) independent,
(ii) mutually exclusive.

11 A bag contains 7 yellow balls and 3 black balls. Four balls are selected at random from the bag, one after the other, without replacement. Let X be the number of black balls selected.
(a) Show that
(i) $\mathrm{P}(\mathrm{X}=0)=\frac{1}{6}$,
(ii) $\mathrm{P}(\mathrm{X}=1)=\frac{1}{2}$.
(b) Construct a table to show the probability distribution of X .
(c) Find the
(i) mean,
(ii) variance of X .

## 12

12 (a) A sports committee of 5 students is to be chosen from 6 boys and 4 girls.

In how many ways can this be done if there must be
(i) 3 boys and 2 girls in the committee,
(ii) more boys than girls in the committee.
(iii) 3 boys and 2 girls and one particular boy refuses to be in the committee with one particular girl.
(b) The word Z I M B A B W E includes the four consonants and the three vowels I, A and E.
(i) Find the number of different arrangements using all the eight letters.
(ii) How many of these arrangements have a consonant at the beginning then a vowel.

13 (a) (i) State one condition which must be satisfied for a situation to be modelled by a binomial distribution.
(ii) In a certain town $28 \%$ of the youths are unemployed.

If 14 youths are chosen randomly in this town, find the probability that fewer than 4 of the youths are unemployed.
(b) (i) The random variable X is normally distributed. The mean is twice the standard deviation. It is given that $(P(X>4,8))=0,8$. Find the standard deviation.
(ii) A normal distribution has mean $\mu$ and standard deviation $\sigma$.

If 600 observations are taken from this distribution, how many observations would be expected to be between $\mu-\sigma$ and $\mu+\sigma$ ?

## 13

14 (a) Table 14.1 shows masses of 200 boys, measured to the nearest kilogram.
Table 14.1

| Mass (kg) | $41-50$ | $51-55$ | $56-60$ | $61-70$ | $71-75$ |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Frequency | 21 | 62 | 55 | 50 | 12 |

On graph paper, draw a histogram to represent the data in the table.
(b) An index is made up by combining 5 items A, B, C, D and E whose weights are $40,20,15,15$ and 10 , respectively. The index set up in the year 1985 and the prices in $Z \$$ for the items were $120,100,110$, 125 and 80 respectively. The prices in 1988 for the 5 items were $150,126,121,175$ and 120 , respectively.
(i) Calculate the price relatives using the given data with 1985 as the base year.
(ii) Using the weights for the 5 items, calculate the weighted index for price relatives for 1988, using 1985 as the base year.

## 15

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## 16

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