ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MATHEMATICS - 9164/2

PAPER 2

JUNE 2016 SESSION 3 hours

Additional materials:
- Answer paper
- Graph paper
- List of Formulae
- Electronic calculator

TIME 3 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **all** questions.

If a numerical answer cannot be given exactly, and the accuracy required is not specified in the question, then in the case of an angle it should be given to the nearest degree, and in other cases it should be given correct to 2 significant figures.

If a numerical value for g is necessary, take $g = 9.81\ ms^{-2}$.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 120.

Within each section of the paper, questions are printed in the order of their mark allocations and candidates are advised, within each section, to attempt questions sequentially.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

This question paper consists of 7 printed pages and 1 blank page.

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Section (A): Pure Mathematics

1 By using the substitution $u = \sin x$, show that

$$\int_{\pi}^{\frac{1}{2}\pi} \frac{\cos x}{3+\cos^2 x}\,dx = \frac{1}{4}ln\frac{1}{3}$$ [8]

2 The gradient of a curve at a point $(x; y)$ is proportional to the product of $\sqrt{x}$ and y^2. The curve passes through the points $(0; -2)$ and $(9; 1)$.

(i) Show that the equation of the curve is $y = \frac{18}{x^{\frac{1}{2}} - 9}$. [8]

(ii) Hence write down an equation of its asymptote. [2]

3 (a) Express in the form $r(\cos\theta + i\sin\theta)$, the roots of the equation $z^7 - 8 - 8i = 0$. [9]

(b) show $Arg(z+1) = \frac{\pi}{3}$ in an Argand diagram. [2]

4 It is given that $y = x^2e^x$.

(i) Show that $\frac{d^3y}{dx^3} = 4e^x + 2xe^x + \frac{d^2y}{dx^2}$. [3]

(ii) Hence, prove by induction that the statement

$\frac{d^ny}{dx^n} = (n-1)(2e^x) + 2xe^x + \frac{d^{n-1}y}{dx^{n-1}}$ is true for all positive integers, n, such that $n \geq 2$. [8]

5 Given the points A(0; 2; 2), B(4; 1; 0) and C(–2 ; 0, 3) find the

(i) value of q, given that the Cartesian equation of a perpendicular bisector of a line joining the points A and B, passing through point D $(1; q; 0)$ is $x - 2 = \frac{2y-3}{4} = z - 1$. [4]

(ii) exact shortest distance of the line in part (i) to the origin, [4]

(iii) Cartesian equation of the plane containing points A, B and C. [4]

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6 (a) The matrix $A = \begin{pmatrix} 2 & k & 4 \\ 3 & 12 & 8 \\ 1 & 8 & k \end{pmatrix}$

(i) Given that A is singular find the exact value of k. [3]

(ii) 1. Given that $k = 5$, find the inverse of A

2. Hence or otherwise solve the following simultaneous equations:

$$2x + 5y + 4z = 1$$
$$3x + 12y + 8z = 1$$
$$x + 8y + 5z = 1$$

[9]

(b) The transformation, P, maps a point A (1; 2) onto A_1 (3; 2) and a point B (2; 5) onto B_1 (7; 5).

(i) Find the matrix representing the transformation P. [3]

(ii) Describe fully the transformation P. [3]

(iii) Given that C is mapped onto C_1 by transformation P, and that the area of triangle ABC is 4 cm^2, find the area of triangle $A_1B_1C_1$. [2]

$\frac{-116}{5} = 5(12) + 8$

$60 + 8$

$\frac{-116 + 68}{5}$

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Section (B): Mechanics

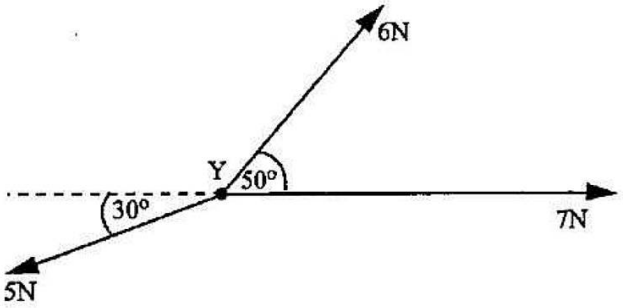
7 The trajectory of a projectile's motion is described by the equation $y = 2x - 0.01x^2$ where x is the horizontal displacement and y is the vertical displacement from the point of projection.

Find the

(i) angle of projection, [1]

(ii) initial velocity of projection. [2]

8



The diagram shows three coplanar forces acting at point Y. The 7 N force is horizontal, the 6 N force is inclined to it at 50° and the 5 N force acts at an angle of 30° below the horizontal.

Find the magnitude and direction of the resultant of the three forces. [5]

9 A particle starts from rest and accelerates at 2 ms^{-2} for 3 seconds. It then maintains the attained velocity for 4 seconds and then finally decelerates at 5 ms^{-2} for 2 seconds.

(a) Sketch a velocity-time graph for the motion of the particle for the 9 seconds. [4]

(b) Calculate the

(i) total distance travelled by the particle in the 9 seconds, [2]

(ii) displacement of the particle at the end of the 9 seconds. [2]

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10 Two identical small trays each of mass 0.2 kg, are connected by a light inextensible string which passes over a fixed smooth pulley, as shown in **Fig. 10.1**. The trays remain balanced.

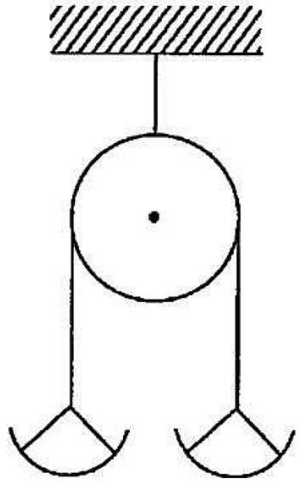


Fig. 10.1

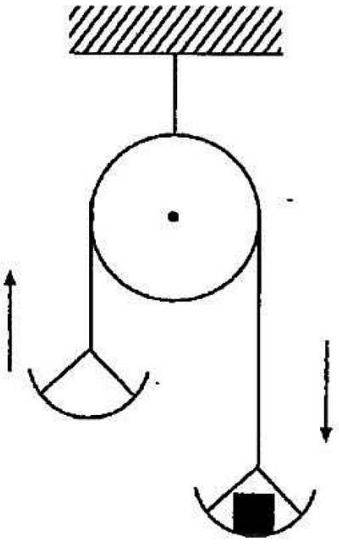


Fig. 10.2

A mass of 80 grammes is then placed on one of the trays, which begins to move downwards, see **Fig 10.2.**

Calculate the

(i) acceleration of the trays and the tension in the string, [5]

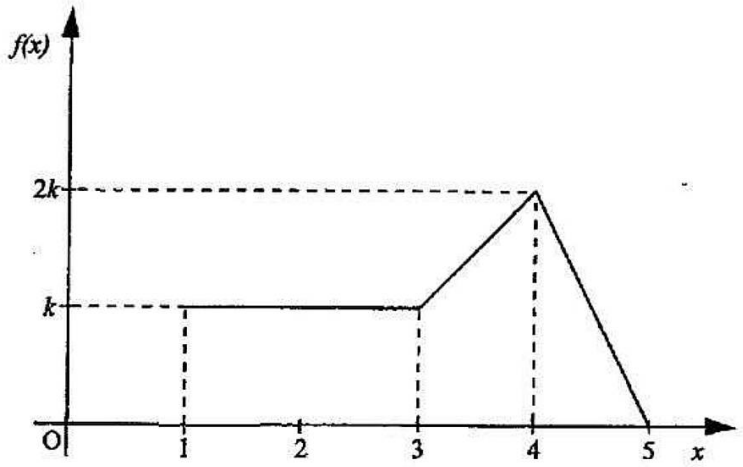
(ii) force exerted on the 80 gramme mass by the tray when in motion. [3]

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Section (C): Statistics

11 A continuous random variable X has a probability density function $f(x)$ given by $f(x) = 0$ for $x < 1$ and for $x > 5$. For x between 1 and 5, its form is shown on the graph.



(a) Show that $k = \frac{2}{9}$. [2]

(b) Construct the probability density function of X. [2]

12 The diameters of washers produced by a particular machine follow a Normal distribution with a standard deviation of 0.1 mm.

Find the mean diameter if there is to be a probability of only 3% that the diameter exceeds 2.0 mm. [4]

13 Bag A contains 3 red balls and 2 white balls. Bag B contains 2 red balls and 3 white balls. A bag is selected at random and two balls are drawn from it, one after the other without replacement.

(a) Find the probability that the two balls drawn are red. [2]

(b) Given that the two balls drawn are red, find the probability that they are from bag A. [3]

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