

NOVEMBER 2023
EBS 424/424J
VECTORS AND MECHANICS
2 HOURS

Candidate's Index Number
Signature:

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
SCHOOL OF EDUCATIONAL DEVELOPMENT AND OUTREACH
INSTITUTE OF EDUCATION

COLLEGES OF EDUCATION
FOUR-YEAR BACHELOR OF EDUCATION (B.ED)
FOURTH YEAR, END-OF-SECOND SEMESTER EXAMINATION, NOVEMBER 2023

10TH NOVEMBER 2023 VECTORS AND MECHANICS 2:00 PM – 2:40 PM

This paper consists of two sections, A and B. Answer ALL the questions in Section A and TWO questions from Section B. Section A will be collected after the first 30 minutes.

SECTION A
[20 MARKS]

Answer ALL the questions in this Section.

Items 1 to 20 are stems followed by four options lettered A to D. Read each item carefully and circle the letter of the correct or best option.

1. Calculate the components of vector $\overrightarrow{PQ} = (50 \text{ km}, 270^\circ)$.
 - A. $\overrightarrow{PQ} = \begin{pmatrix} -50 \\ 0 \end{pmatrix}$
 - B. $\overrightarrow{PQ} = \begin{pmatrix} 0 \\ 50 \end{pmatrix}$
 - C. $\overrightarrow{PQ} = \begin{pmatrix} 0 \\ -50 \end{pmatrix}$
 - D. $\overrightarrow{PQ} = \begin{pmatrix} 50 \\ 0 \end{pmatrix}$
2. If the velocity-time graph is a horizontal line, what does it indicate? The object is
 - A. accelerating.
 - B. at rest.
 - C. decelerating.
 - D. moving at a constant speed.
3. If the velocity-time graph is a straight line inclined with the time axis, what does it indicate? It means the object is
 - A. accelerating uniformly.
 - B. at rest momentarily.
 - C. decelerating uniformly.
 - D. moving with uniform velocity.

4. If vector $\mathbf{a} = 3\mathbf{i} + 4\mathbf{j}$ and $\mathbf{b} = 2\mathbf{i} - 3\mathbf{j}$, find $\mathbf{a} \cdot \mathbf{b}$.
- A. -8
 - B. -7
 - C. -6
 - D. -5

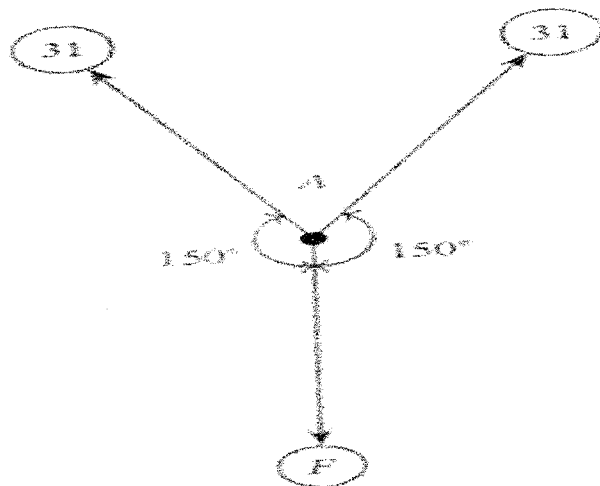
5. If $\mathbf{u} = \mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$, $\mathbf{v} = -5\mathbf{i} + 3\mathbf{j} - 7\mathbf{k}$ and $\mathbf{w} = -\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$, then $\mathbf{u} \cdot (\mathbf{v} \times \mathbf{w}) = \dots\dots\dots$
- A. 0
 - B. 1
 - C. 2
 - D. 3

6. What is the resolved form for a vector which is 5 units long and is inclined at an angle of 45 degrees to the positive x-axis?
- A. $\frac{1}{\sqrt{2}}\mathbf{i} + \frac{1}{\sqrt{2}}\mathbf{j}$
 - B. $\frac{5}{\sqrt{2}}\mathbf{i} + \frac{5}{\sqrt{2}}\mathbf{j}$
 - C. $\frac{5}{\sqrt{2}}\mathbf{i} + \frac{15}{\sqrt{2}}\mathbf{j}$
 - D. $\frac{10}{\sqrt{2}}\mathbf{i} + \frac{10}{\sqrt{2}}\mathbf{j}$

7. Determine the direction cosines of the vector $\mathbf{r} = 3\mathbf{i} - 2\mathbf{j} + 6\mathbf{k}$.
- A. $\frac{3}{13}$, $-\frac{2}{13}$ and $\frac{6}{13}$
 - B. $\frac{3}{11}$, $-\frac{2}{11}$ and $\frac{6}{1}$
 - C. $\frac{3}{7}$, $-\frac{2}{7}$ and $\frac{6}{7}$
 - D. $\frac{3}{8}$, $-\frac{1}{4}$ and $\frac{3}{4}$

8. In the given figure, particle A is in equilibrium under the effect of the forces shown which are in newtons. Find the force F.

- A. $31\sqrt{2}$ N
- B. $31\sqrt{3}$ N
- C. $31\sqrt{5}$ N
- D. $31\sqrt{7}$ N

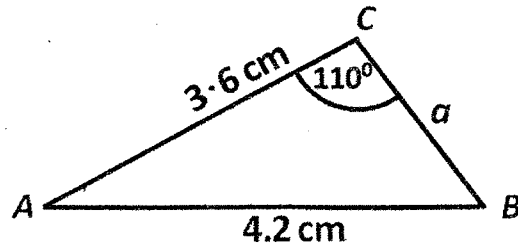


9. Find the vector product of \mathbf{a} and \mathbf{b} where $\mathbf{a} = \mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$ and $\mathbf{b} = 2\mathbf{i} + 7\mathbf{j} - 5\mathbf{k}$
- A. $-18\mathbf{i} + 12\mathbf{j} - 3\mathbf{k}$
 - B. $-28\mathbf{i} + 13\mathbf{j} + 3\mathbf{k}$
 - C. $-33\mathbf{i} + 14\mathbf{j} + 6\mathbf{k}$
 - D. $-43\mathbf{i} + 13\mathbf{j} + \mathbf{k}$

10. Find the parametric vector equation of a line passes through the points $A(2, 5)$ and $B(-4, 1)$.
- $x = 2 + 6t$ and $y = 5 + 4t$, where t is a scalar.
 - $x = 2 + 6t$ and $y = 5 - 4t$, where t is a scalar.
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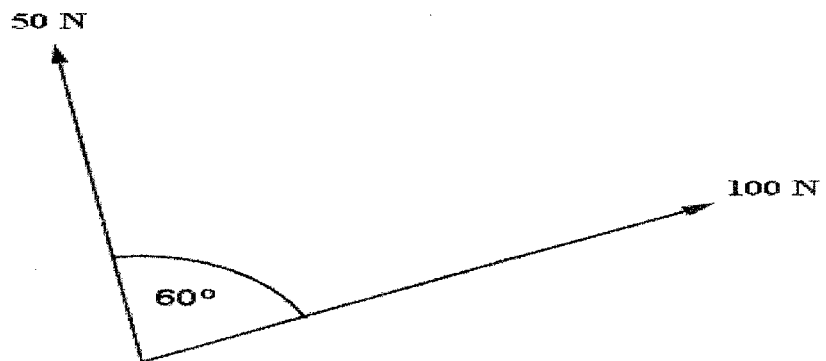
11. In triangle ABC , $b = 3.6$ cm, $c = 4.2$ cm and angle $C = 110^\circ$. Find the size of angle B .

- 48.2°
- 35.2°
- 62.3°
- 53.7°



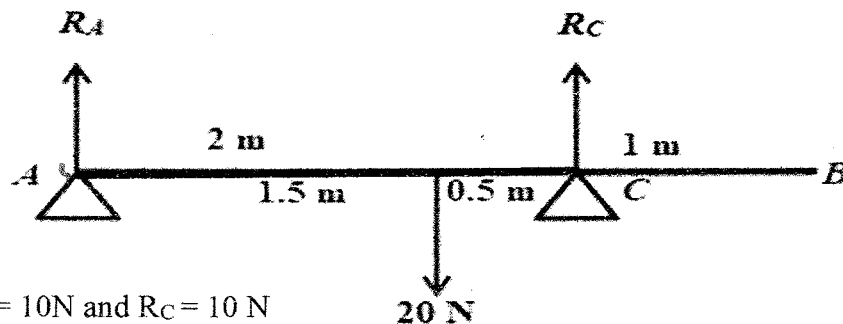
12. In the diagram below, the forces of magnitude 50 N and 100 N are the oblique components of a force F . What is the magnitude of the force, F ?

- 123.23 N
- 132.29 N
- 145.46 N
- 150.00 N



13. Find the sum of the components of the forces $a = (20 \text{ N}, 030^\circ)$ and $b = (30 \text{ N}, 120^\circ)$ along the y -axis.
- $10 - 15\sqrt{3}$
 - $10 + 15\sqrt{3}$
 - $10\sqrt{3} - 15$
 - $10\sqrt{3} + 15$

14. The diagram below shows a uniform rod of length 3 m and weight 20 N resting horizontally on supports at A and C , where $AC = 2$ m. Calculate the magnitude of the normal reaction at both supports.



- $R_A = 10\text{N}$ and $R_C = 10 \text{ N}$
- $R_A = 7\text{N}$ and $R_C = 13 \text{ N}$
- $R_A = 5\text{N}$ and $R_C = 15 \text{ N}$
- $R_A = 3\text{N}$ and $R_C = 17 \text{ N}$

15. Find the angle that vector $\mathbf{a} = 6\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$ makes with x -axis.
- A. 21°
 - B. 31°
 - C. 41°
 - D. 51°
16. A body of mass 12 kg increases its speed from 6 ms^{-1} to 16 ms^{-1} in 5 s. Find the force that was acting on the body.
- A. 18 N
 - B. 24 N
 - C. 36 N
 - D. 42 N
17. If the vector $\mathbf{c} = \mathbf{a} + 2\mathbf{b}$ and $2\mathbf{c} = \mathbf{a} - 3\mathbf{b}$. Express vector \mathbf{a} in terms of \mathbf{b} .
- A. $\mathbf{a} = -3\mathbf{b}$
 - B. $\mathbf{a} = 7\mathbf{b}$
 - C. $\mathbf{a} = \frac{2}{5}\mathbf{b}$
 - D. $\mathbf{a} = \frac{7}{5}\mathbf{b}$
18. A body of mass 15 kg is placed on an inclined plane at an angle of 30° to the horizontal. What is the reaction force perpendicular to the plane, to the nearest whole number? [Take $g = 9.8 \text{ ms}^{-2}$]
- A. 74 N
 - B. 85 N
 - C. 118 N
 - D. 127 N

Use the information below to answer questions 19 and 20.

Forces $F_1 = (5 \text{ N}, 090^\circ)$ and $F_2 = (8 \text{ N}, 180^\circ)$ act on a body of mass 5 kg initially at rest.

19. Find the acceleration with which the body begins to move.
- A. 1.09 ms^{-2}
 - B. 1.88 ms^{-2}
 - C. 1.89 ms^{-2}
 - D. 2.03 ms^{-2}
20. Calculate the magnitude of the resultant force on the body.
- A. 9.4 N
 - B. 10.8 N
 - C. 11.5 N
 - D. 12.0 N