



UNIVERSITY OF JOHANNESBURG

Applied Mathematics 1A10

TEST 2

21 April 2016

TIME: 90 min

MARKS: 40

INSTRUCTIONS:

- Write your student number and phone number.
- Start with any question. Each subsequent question must start on a new page.
- Do all four questions.
- Use proper notations e.g. **bars** for vectors, and no bars for their magnitudes.
- Show **arrow-heads** in line segments, for vectors such as \bar{a}, \bar{b} , etc.
- Calculators may be used for the **final answer** only. In such a case, the answer must be correct to **two** decimal places.
- Do not forget the **lecture** today at 16:20.

Figure 1

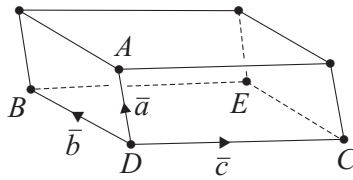


Figure 2

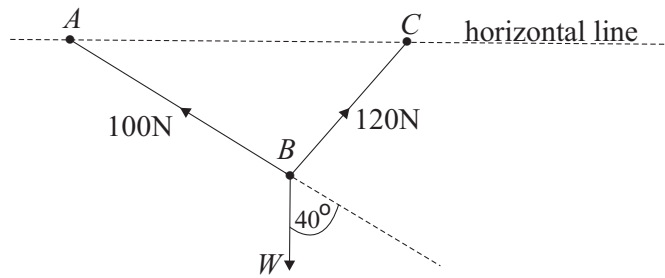


Figure (3.1)

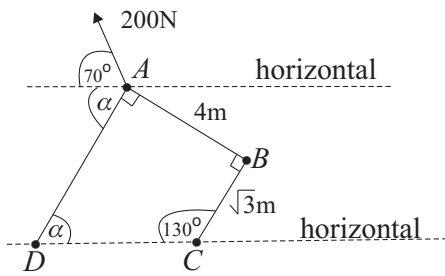


Figure (3.2)

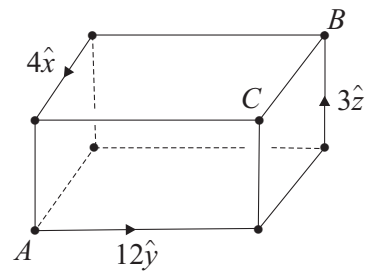
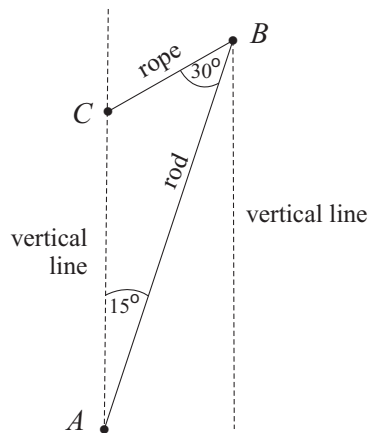


Figure 4



Question 1

Suppose $\bar{a} = \overline{DA} = 2\hat{x} - 3\hat{y} + 4\hat{z}$, $\bar{b} = \overline{DB} = \hat{x} + 2\hat{y} - \hat{z}$ and $\bar{c} = \overline{DC} = 3\hat{x} - \hat{y} + 2\hat{z}$ in the given figure 1 of a parallelepiped.

(1.1) Calculate the volume of the parallelepiped.

(1.2) Calculate the area of the face with edges DB and DC (the face $BDCE$).

(1.3) How far (shortest distance) is A from the plane that has points B, C, D, E ?

[HINT: You may use your results of (1.1) and (1.2).] [10]

Question 2

A particle (weight W) is suspended at B , in the earth's gravitational field, using ropes AB and BC as shown in the given figure. The tensions in AB and BC are 100N and 120N respectively.

(2.1) Calculate $\angle ABC$.

[You may use a horizontal X -axis through B .]

(2.2) Calculate the weight W .

[You may use Lami's theorem of sine or cosine rule.] [10]

Question 3

(3.1) Determine the magnitude and sense of the moment of the 200N-force about the point C of figure (3.1). C is not in the line of action of the force.

(3.2) A 130N-force is applied at point A in the direction towards B of figure (3.2). Calculate its moment about the point C . Note that $\hat{x} \times \hat{y} = \hat{z}$ in the figure. [10]

Question 4

Figure 4 is a FBD of a uniform rod AB of weight 100N. The rod can rotate freely around A , by means of a pin. However, it is held in equilibrium, at an angle of 15° with the upward vertical, by means of a rope that is tied at B and forms an angle of 30° with the rod and is in the same vertical plane as the rod.

(4.1) Calculate the tension T in the rope BC .

(4.2) Calculate R , the magnitude of the reaction force, by the pin, at A .

[You may use Lami's cosine rule at B or C for (4.2).] [10]

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