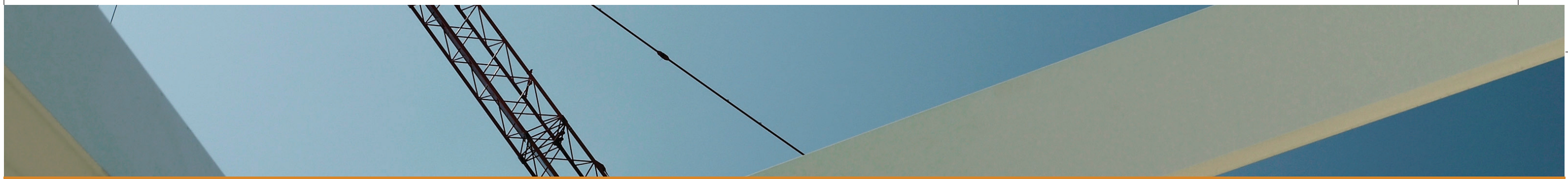


FE Exam Review Problems

The Fundamentals of Engineering (FE) examination [see *http://ncees.org/exams/fe-exam/*] is the first step on the path to registration as a Professional Engineer (P.E.). In its current form, the FE exam is a computer-based test (CBT) and is closed book with an electronic reference. The FE exam contains 110 multiple-choice questions and examinees have six hours to complete the exam. The six-hour time also includes a tutorial, a break, and a brief survey at the conclusion. Exam questions use both the International System of Units (SI) and the US Customary System (USCS). The FE is offered in the following seven disciplines: Chemical; **Civil**; Electrical and Computer; Environmental; Industrial; **Mechanical**; and **Other** Disciplines. Exams in all disciplines have questions on such topics as mathematics, ethics, engineering economy, etc., followed by discipline-specific questions to make up the 110-problem total. The NCEES *FE Reference Handbook* is the only reference material that can be used during the exam.

In the past, approximately 20% of the questions on the **Civil**, **Mechanical** and **Other Discipline** specific exams have been based on principles presented in undergraduate courses in engineering mechanics. This appendix presents more than 160 FE−type review problems in the two subject areas of *Statics* and *Mechanics of Materials*, many of which are based upon modifications of problems presented at the end of each chapter throughout this text. The problems cover all of the major topics presented in Parts 1 and 2 of the text and are thought to be representative of those likely to appear on an FE exam. Problem numbers are based on the textbook chapter that presents the relevant subject matter; for example, Problem 2.1 is concerned with forces, moment, and resultants. Most of these problems are in SI units and require use of an engineering calculator to carry out the solution. Each of the problems is presented in the FE exam multiple-choice format. The student must select from four available answers (A, B, C, or D), only one of which is the correct answer. The correct answer choices are listed in the Answers posted on this website, and the detailed solution for each problem is available for download on the student website. It is expected that careful review of these problems will serve as a useful guide to the student in preparing for this important examination.

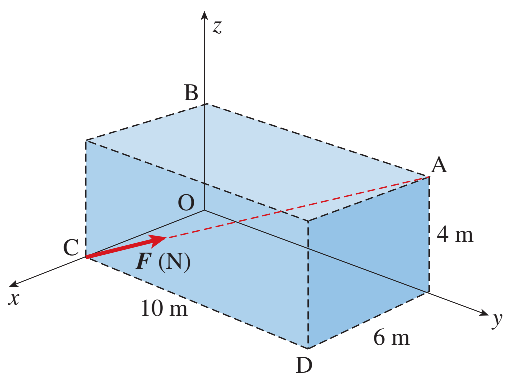
Part 1: STATICS

Vector analysis

1.1 The *sum* of *orthogonal* vectors $\boldsymbol{V}_1$ and $\boldsymbol{V}_2$ is $(4\boldsymbol{i} - 8\boldsymbol{j} + 7\boldsymbol{k})$. A unit vector along $\boldsymbol{V}_1$ is $(0.635i + 0.773j)$. Vector $\boldsymbol{V}_1$ is:

(A) $0.635\boldsymbol{i} + 0.773\boldsymbol{j}$
(B) $-1.635\boldsymbol{i} + 2.773\boldsymbol{j}$
(C) $-2.35\boldsymbol{i} - 2.82\boldsymbol{j}$
(D) $2.57\boldsymbol{i} - 1.73\boldsymbol{j}$

1.2 Force $\boldsymbol{F}$ (see figure) is applied at C and is directed toward A. Its magnitude is $F = 15$ N. A unit vector along line CA is:
(A) $-0.49\boldsymbol{i} + 0.81\boldsymbol{j} + 0.32\boldsymbol{k}$
(B) $-0.51\boldsymbol{i} + 0.73\boldsymbol{j} + 0.39\boldsymbol{k}$
(C) $0.58\boldsymbol{i} - 0.79\boldsymbol{j} + 0.49\boldsymbol{k}$
(D) $-0.65\boldsymbol{i} + 0.22\boldsymbol{j} + 0.43\boldsymbol{k}$



1.3 The *direction cosines* of the vector $(4\boldsymbol{i} - 8\boldsymbol{j} + 7\boldsymbol{k})$ are:

(A) (0.35, 0.81, −0.23)
(B) (0.52, 0.48, −0.21)
(C) (−0.38, 0.21, −0.26)
(D) (0.35, −0.70, 0.62)

1.4 Vectors $\boldsymbol{V}_1$ and $\boldsymbol{V}_2$ are orthogonal. If $\boldsymbol{V}_1$ is $(5\boldsymbol{i} + 7\boldsymbol{j} - 3\boldsymbol{k})$ and $\boldsymbol{V}_2 = (7\boldsymbol{i} + V_y\boldsymbol{j} + 14\boldsymbol{k})$, then component V_y in vector $\boldsymbol{V}_2$ is:

(A) 3.6
(B) 1.0
(C) −5.2
(D) 2.7

1.5 Vector $\boldsymbol{V}_1$ is $(5\boldsymbol{i} + 7\boldsymbol{j} - 3\boldsymbol{k})$ and $\boldsymbol{V}_2 = (7\boldsymbol{i} + 2\boldsymbol{j} + 14\boldsymbol{k})$. The *scalar product* of these two vectors is:

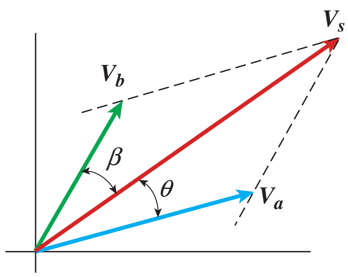
(A) 7.0
(B) −5.8
(C) 2.5
(D) 3.4

1.6 Vector V_1 is ($5i + 7j - 3k$) and $V_2 = (7i + 2j + 14k)$. The *vector product* of these two vectors is:

(A) $-104i + 72j - 39k$
(B) $-124i + 62j - 33k$
(C) $104i - 91j - 39k$
(D) $-114i - 12j + 91k$

1.7 The magnitudes of two vectors V_a and V_b are 5 and 7, respectively, and the magnitude of their sum V_s is 10 (i.e., $|V_a| = 5$, $|V_b| = 7$, $|V_s| = 10$). The angles θ and β in the figure below are:

(A) $\theta = 40.5°$, $\beta = 27.7°$
(B) $\theta = 27.5°$, $\beta = 40.7°$
(C) $\theta = 48.5°$, $\beta = 37.7°$
(D) $\theta = 14.5°$, $\beta = 17.3°$



1.8 Vector V_1 is ($5i + 7j - 3k$), vector V_2 is ($7i + 2j + 14k$), and vector V_3 is ($i - 2j + 5k$). The *scalar triple product* $V_1 \cdot (V_2 \times V_3)$ is:

(A) -91
(B) 82
(C) 56
(D) 91

1.9 Vector V_1 is ($5i + 7j - 3k$) and vector V_2 is ($7i + 2j + 14k$). The component of V_1 *parallel to* the line of action of vector V_2 is:

(A) $-0.25i + 0.12j + 0.43k$
(B) $0.20i + 0.06j + 0.39k$
(C) $-0.20i + 0.22j + 0.39k$
(D) $-0.35i + 0.02j + 0.13k$

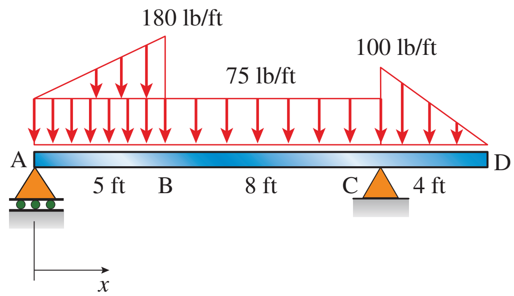
1.10 Vector V_1 is ($5i + 7j - 3k$) and vector V_2 is ($7i + 2j + 14k$). The component of V_1 *perpendicular to* the line of action of vector V_2 is:

(A) $4.80i + 6.94j - 3.39k$
(B) $4.80i - 6.94j - 3.39k$
(C) $4.80i - 6.94j + 3.39k$
(D) $-4.80i + 6.94j - 3.39k$

Resultants of force systems; equivalent force systems

2.1 The distributed loading on beam ABCD is to be replaced by a statically equivalent set of forces. The *magnitude* and *location* of the statically equivalent force on beam segment AB are:

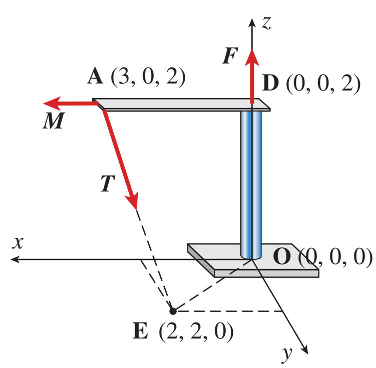
(A) 575 lb, 4.1 ft
(B) 638 lb, 4.2 ft
(C) 740 lb, 3.9 ft
(D) 428 lb, 4.4 ft



2.2 Bracket ADO is acted on by forces $\boldsymbol{F}$ and $\boldsymbol{T}$ and couple $\boldsymbol{M}$ (see figure). Assume that $F = 8$ N, $T = 9$ N and $M = 12$ N·m. Joint coordinates are in meters.

The resultant force vector $\boldsymbol{R}$ (in newtons) is:

(A) $-5\boldsymbol{i} + 7\boldsymbol{j} + 1\boldsymbol{k}$
(B) $-3\boldsymbol{i} + 4\boldsymbol{j} - 3\boldsymbol{k}$
(C) $-6\boldsymbol{i} + 5\boldsymbol{j} + 4\boldsymbol{k}$
(D) $-3\boldsymbol{i} + 6\boldsymbol{j} + 2\boldsymbol{k}$

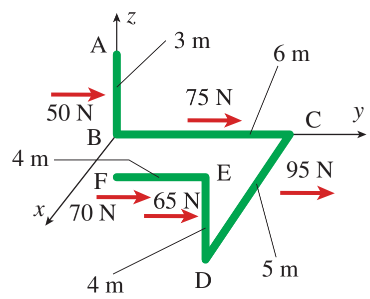


2.3 The resultant moment vector $\boldsymbol{M}_R$ at point O in Problem 2.2 is (in N·m) :

(A) $12\boldsymbol{j} + 18\boldsymbol{k}$
(B) $-15\boldsymbol{i} + 12\boldsymbol{k}$
(C) $18\boldsymbol{j} + 12\boldsymbol{k}$
(D) $-12\boldsymbol{i} + 18\boldsymbol{j}$

2.4 On bracket ABCDEF, each y-direction force acts at the center of the bar segment to which it is applied (see figure). All turns of ABCDEF are 90º angles. The *resultant moment at* B ($\boldsymbol{M}_B$) for this parallel force system is (in N·m) :

(A) $395\boldsymbol{j} + 1080\boldsymbol{k}$
(B) $415\boldsymbol{i} + 875\boldsymbol{k}$
(C) $485\boldsymbol{i} - 913\boldsymbol{k}$
(D) $-485\boldsymbol{i} + 913\boldsymbol{k}$



2.5 Forces and couples are applied to ABCDE as shown in the figure. All turns of ABCDE are 90º angles. The statically equivalent moment at A ($\boldsymbol{M}_A$) for the force−couple system is (in N·m) :

(A) $-160\boldsymbol{i} + 575\boldsymbol{j} + 1480\boldsymbol{k}$
(B) $160\boldsymbol{i} + 425\boldsymbol{j} + 1380\boldsymbol{k}$
(C) $-160\boldsymbol{i} + 325\boldsymbol{j} + 1380\boldsymbol{k}$
(D) $-160\boldsymbol{i} + 325\boldsymbol{j} - 1480\boldsymbol{k}$