

1)

(a)	the force (needed to stretch a spring is directly) is proportional to the extension (of the spring from its natural length) or equation with all terms defined ✓ up to the limit of proportionality ✓	2
(b) (i) QWC	descriptor	mark range
good - excellent	The candidate provides a comprehensive and coherent description which includes all the necessary measurements in a logical order. The description should show awareness of the need to use a range of standard masses. In addition, the use of the measurements is explained clearly, including an outline of a graphical method to find the mass of the rock sample, or calculation using two or more standard masses and averaging. For 6 marks there must be a description of how to make accurate measurements.	5 - 6
modest - adequate	The candidate's description includes the necessary measurements using one standard mass as well as the rock sample. The description may not be presented in a logical order and they show little consideration in relation to making the measurements accurately. A clear explanation is provided of how to find the mass of the rock sample from their measurements, including correct use of Hooke's law through calculations or inadequate graphical method.	3 - 4
poor - limited	The candidate knows the necessary measurements to be made using a standard mass and the rock sample. The explanation of how to find the mass of the rock sample may be sketchy. The explanations expected in a competent answer should include a coherent account of the following measurements and their use measurements (use a metre rule to) measure the length of the spring ✓ when it supports a standard mass (or known) mass (m) and when it supports the rock sample repeat for different (standard) masses accuracy – use a set square or other suitable method to measure the position of the lower end of the spring against the (vertical) mm rule or method to reduce parallax use of measurements either plot graph of mass against length (or extension) ✓ read off mass corresponding to length (or extension) due to the sample ✓ or the extension of the spring = length – unstretched length ✓ mass of rock sample = $\frac{\text{extension of spring supporting rock sample}}{\text{extension of spring supporting known mass}} \times M$ ✓	1 – 2

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S Ben Porath



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substructures are defined using the substructure generation procedure the substructure creation and usage cannot be included in the same analysis multiple substructures can be generated in an analysis any substructure can consist of one or more other substructures if this is the case the nested level substructures must be defined first

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generating a substructure a single analysis can include multiple substructure generate steps and abaqus cae creates corresponding output database files for each step multiple preloading steps can precede every substructure generation step in your analysis

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this example shows you how to create a substructure and use it four times in the model as a leg support for storage vessel

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a substructure database is the set of files that describe the mechanical and geometrical properties of a substructure and abaqus writes all substructure data to the substructure database during the substructure generation analysis

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dec 17 2013 i have created a substructure in abaqus as output i will like to see the substructure matrices mass stiffness and damping matrices however i m only able to write the mass and stiffness matrices to an output file mtx does anyone know how to create an output file including both the mass stiffness and damping matrices of the substructure

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the basic substructuring idea is to consider a substructure a part of the model separately and eliminate all but the degrees of freedom needed to connect this part to the rest of the model so that the substructure appears in the model as a substructure a collection of finite elements whose response is defined by the stiffness and mass o

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limitations of structural elements membrane elements cannot be used to overlay a substructure that consists of second order three dimensional brick elements of type c3d20 r h if the substructure will be used as a slave surface normally abaqus standard automatically converts c3d20 r h brick elements to elements with midface nodes c3d27 r h because this

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in abaqus standard the response within a substructure once it has been reduced to a substructure is considered to be a linear perturbation about the state of the substructure at the time it is made into a substructure

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set this parameter equal to yes default if the substructure eigenproblem needs to be solved during substructure generation in abaqus substructure eigenvectors can be used to define substructure modal damping for a given substructure abaqus standard will evaluate the stiffness associated with frequency dependent springs and dashpots at

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the purpose of this example is to provide basic demonstration and verification of the substructuring capabilities in abaqus problem description the example is a frame consisting of two columns connected by a beam figure 1 16 1 1 the columns and the beam are each modeled with 10 elements of type b21 once a substructure has been