UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

NATIONAL DIPLOMA IN APPLIED BUILDING

MODULE PHY1YKT
APPLIED BUILDING SCIENCE
CAMPUS **DFC**

DECEMBER EXAMINATION

DATE 02/12/2015 **SESSION: 11:30 - 14:30**

ASSESSOR **DR P L MASITENG**

INTERNAL MODERATOR **DR S M RAMAILA**

DURATION 3 HOURS **MARKS 123**

NUMBER OF PAGES: 12 PAGES, INCLUDING 3 INFORMATION SHEETS

INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)

REQUIREMENTS: 1 MULTIPLE CHOISE ANSWER SHEET

SECTION A – MULTIPLE CHOICE

ANSWER THIS SECTION ON THE OPTICAL ANSWER SHEET.

1. A solid cylindrical steel column is 4 m long and 9 cm in diameter. Young's modulus for steel is 1.9×10^{11} Pa. The decrease in the length of the column when carrying a load of 80 000 kg will be:

   A 26.5 mm
   B 2.6 mm
   C 64.9 mm
   D 0.058 mm

Questions 2 and 3 refer to the following information.

A metal wire 75 cm long and 0.13 cm in diameter stretches 0.035 cm when a load of 8 kg is hung on its end.

2. The stress in the wire is:

   A 6.03×10^6 Pa
   B 3.84×10^4 Pa
   C 1.48×10^7 Pa
   D 5.91×10^7 Pa

3. The strain in the wire is:

   A 4.67×10^{-4}
   B 1.73×10^{-3}
   C 9.38
   D 2.14×10^3

4. A circular steel wire 2 m long is to stretch no more than 0.25 cm when a tensile force of 400 N is applied to it. The minimum diameter required is:

   A 1.6×10^{-3} mm
   B 0.71 mm
   C 0.14 mm
   D 1.4 mm

5. A nylon rope used by mountaineers stretches by 1.1 m under the weight of a 65 kg climber. The rope is 45 m long and 7 mm in diameter. The cross-sectional area of the rope is:

   A 3.85×10^{-5} m^2
   B 1.54×10^{-4} m^2
   C 154 m^2
   D 38.5 m^2

6. Young' modulus for the rope material in question 5 is:

   A 677 MPa
   B 69 MPa
   C 169 MPa
   D 17.3 MPa

7. A metal rod that is 4 m long and 0.5 cm^2 in cross-section area is found to stretch 0.2 cm under a tension of 5000 N. Young's modulus for this metal is:

A 200 MPa
B 20 MPa
C 1 960 GPa
D 200 GPa

8. Luminous intensity is defined as:

A the amount of light falling onto a surface
B the flow of light through air
C $\frac{total\ \ flux}{total\ \ area}$
D the amount of light given off by a source

9. A 100 W light bulb of luminous intensity 60 cd is suspended 3 m above the floor. The luminous flux of the lamp is:

A 60 lumens
B 745 lumens
C 4.8 lumens
D 6.67 lumens

10. The illumination directly below the lamp in question 9 is:

A 754 lux
B 60 lux
C 6.67 lux
D 20 lux

11. The height of the lamp in question 9 in order to half the illumination is:

A 4.24 m
B 1.5 m
C 6 m
D 1.8 m

12. A 64 cd lamp and a 36 cd lamp are placed 70 cm apart. Where, on a straight line between them, will a photometer balance?

A 35 cm from 64 cd lamp
B 25 cm from 36 cd lamp
C 50 cm from 36 cd lamp
D 40 cm from 64 cd lamp

13. A transverse wave is a wave of which

A the displacement of the particles of the medium is perpendicular to the direction in which the wave travels
B the displacement is parallel to the direction in which the wave travels
C the displacement is in the same direction as the direction in which the wave travels
D the displacement is opposite to the direction in which the wave travels

14. The definition of the frequency of a wave is:

A the maximum displacement of the particles of the particles of the medium from the rest position
B the distance between a wave crest and wave trough
C the distance between two successive wave crests
D the number of wave crests passing a fixed point in 1 second

15. A cannon produces a 90 dB sound level at a certain distance from a sound meter. The reading on the meter when two such cannons are fired at the same time is:

A 180 dB
B 93 dB
C 90 dB
D 45 dB

16. A sound level meter placed in front of the loudspeaker of a 60 W sound system reads 70 dB. All else being equal, when placed in front of a 120 W system, the meter will read

A 120 dB
B 140 dB
C 63 dB
D 73 dB

17. The exterior wall of a lecture room faces a main road and has a sound reduction index of 35 dB at 1 000 Hz. How much louder is the traffic noise outside the room than it is inside the room?

A 35 times as loud
B 11.3 times as loud
C 10 times as loud
D 20 times as loud

18. A stone grinding machine produces a sound intensity level of 85 dB. The intensity level of 3 such machines operated at the same time is:

A 80 dB
B 23.8 dB
C 89.8 dB
D 84.8 dB

19. Density is by definition a body's

A mass to weight ratio
B weight to volume ratio
C mass to volume ratio
D volume to mass ratio

20. The weight of the air in a room with a 4 m x 5 m floor and a ceiling 3 m high is (the density of air = 1.2 kg m^{-3})

A 72 kg
B 24 kg
C 705.6 N
D 235.2 N

21. The side length of a 37 kg cube of platinum is (the relative density of platinum =21.4)

A 0.12 m
B 1.2 m
C 0.04 m
D 1.3 m

22. 50 cm^3 of water has a mass of

A 0.5 kg
B 50 kg
C 5 kg
D 0.05 kg

23. The RD of aluminium is 2.7. The density of aluminium expressed in SI-units is:

A 2 700 kg m^{-3}
B 2.7 g cm^{-3}
C 2.7 kg m^{-3}
D 0.0027 kg m^{-3}

24. Archimedes' principle states that the upthrust experienced by a body totally immersed in a liquid is equal to

A the mass of the body
B the weight of the body
C the weight of the displaced liquid
D the mass of the displaced liquid

25. A solid cube with side length 1.5 cm and density 10.5 x10^3 kg m^{-3} floats on an unknown liquid. If the cube is submerged to a depth of 1.16 cm, the density of the liquid is: (in kg m^{-3})

A 13.6 x 10^3
B 1 x 10^3
C 10.5 x 10^3
D 900

26. A body of weight 20 N floats on a liquid. The weight of the displaced liquid is:

A 0 N
B less than 20 N
C 20 N
D more than 20 N

27. A body has a weight of 250 N in air and 152 N in water. The volume of the body is:

A 0.01 cm^3
B 0.01 m^3
C 250 m^3
D 152 cm^3

28. The area of the face of the small piston of a hydraulic press is 10 cm^2. An input force of 100 N is applied to this piston and the resulting force on the large piston is 9 600 N. The area, in cm^2, of the face of the large piston is:

A 9 600
B 10
C 96
D 960

29. A surveyor uses a steel measuring tape that is exactly 50 m long at a temperature of 20 ^oC. The length of the tape on a hot summer day when the temperature is 35 ^oC is:

A 50.0303 m
B 49.9917 m
C 50.0083m
D 49.9697 m

30. An aluminium cube has a side length of 4 cm at 10 ^0C and is heated to 100 ^oC. The change in volume of the cube is:

A 0.024 cm^3
B 1,127 cm^3
C 0,095 cm^3
D 0,38 cm^3

31. The final temperature when 80 g water at 60 ^oC is mixed with 60 g water at 20 ^oC is:

A 40 ^oC
B 50 ^oC
C 42.9 ^oC
D 30.5 ^oC

32. A block of ice, mass 0,51 kg, at 0 ^oC melts and in the process absorbs heat to the amount of:

A 1 675 J
B 1 675 kJ
C 170.9 J
D 170.9 kJ

33. Specific latent heat of fusion is the heat

A gained by a solid when changing into a liquid
B gained by 1 kg of a solid when changing into a liquid
C released by a gas when changing into a liquid
D gained by a liquid when changing into a gas

34. A Styrofoam box used to keep drinks cold on the beach has a total wall area (including the lid) of 0.8 m^2 and a wall thickness of 2 cm. The rate of heat flow into the box if the temperature inside the box is 0 ^oC and the outside temperature is 30 ^oC is (the k value of Styrofoam=0.01 W m^{-1} $^oC^{-1}$)

A 0.12 W
B 120 W
C 1.2 W
D 12 W

7\...

35. A square aluminium bar is placed in tension by a force of 500 kN. The dimensions of the bar if the stress is not to exceed 20 MPa is:

A 0.158 m
B 19.66 m
C 1.234 m
D 20.45 m

36. A wire with cross-sectional area 4 mm^2 is stretched by 0.1 mm when a certain weight is hung from it. The amount by which a wire of the same material and the same length will stretch if its cross-sectional area is 8 mm^2 and the same weight is hung from it is:

A 0.05 mm
B 0.1 mm
C 0.2 mm
D 0.01 mm

37. The illumination provided by a light source at a distance of 5 m from it is 12 000 lux. The luminous intensity of the source is:

A 480 cd
B 6×10^4 cd
C 2.4×10^3 cd
D 3×10^5 cd

38. A noise-level meter reads the sound level in a room to be 85 dB. The sound intensity in the room is therefore

A 85 W m^{-2}
B 3.16×10^8 W m^{-2}
C 3.16×10^{-4} Wm^{-2}
D 8.5×10^{-12} W m^{-2}

39. A 1.5 kW electric kettle takes 2 minutes 15 seconds to heat an amount of water from 20 ^oC to 94 ^oC. The kettle is 80 % efficient at heating water. The energy supplied is:

A 202.5 J
B 162 J
C 1.62×10^5 J
D 2.025×10^5 J

40. The energy used in question 39 is:

A 2.53×10^5 J
B 1.5×10^3 J
C 2.025×10^{5} J
D 1.62×10^5 J

41. The mass of water heated in question 39 is:

A 0.81 kg
B 0.65 kg
C 0.52 kg
D 4.8×10^{-3} kg

8\...

42. The coefficient of linear expansion is defined as:

   A expansion for every degree temperature change
   B change in length for every degree temperature change
   C change per unit length for a change in temperature
   D change per unit length for every degree temperature change

TOTAL SECTION A: 84

SECTION B

ANSWER THIS SECTION IN FULL IN THE ANSWER SCRIPT.

QUESTION 1

A carpenter builds an outside house wall with a layer of wood 3 cm thick on the outside and a layer of Styrofoam insulation 2.2 cm thick as the inside wall surface.

Given:

K_{wood} = 0.08 W m^{-1} ^{o}C^{-1}
$K_{styrofoam}$ = 0.01 W m^{-1} ^{o}C^{-1}

The interior surface temperature is 19 ^{o}C and the outside surface temperature is -10 ^{o}C

Calculate:

1.1 The rate of heat flow through the wall if the area of the wall is 12 m^2.

1.2 The temperature between the wood and the Styrofoam.

(8)

[8]

QUESTION 2

Water enters a house through a pipe with an inside diameter of 2 cm at a pressure of 4 x 10^5 Pa. A 1 cm diameter pipe leads to the first-floor bathroom 5 m above. The flow speed in the 2 cm diameter pipe is 1.5 m s^{-1}.

Calculate:

2.1 The flow speed in the 1 cm diameter pipe. (3)

2.2 The pressure in the 1 cm diameter pipe on the first floor. (5)

2.3 The flow rate in the pipes. (2)

[10]

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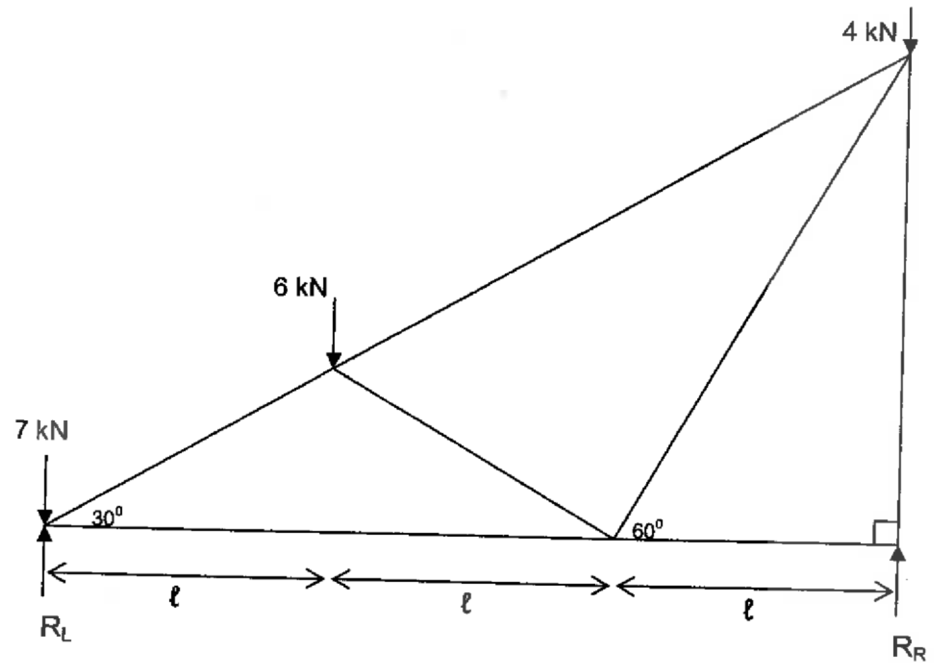
QUESTION 3

The diagram shows a loaded framework. Determine the reaction forces R_L and R_R and the magnitude and nature of the forces in the members. Use Bow's notation and tabulate your results.



[21]

Total Section B = 39

Grand Total = 123