UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

MODULE	**PHY1CA1**
CAMPUS	**DFC**
EXAM	**JUNE 2015**

DATE:	**6/6/2015**	**SESSION**	**12:30 -15:30**
ASSESSOR(S)		**DR S.M. RAMAILA**	
INTERNAL MODERATOR		**DR L.P. MASITENG**	
DURATION:	**3 HOURS**	**MARKS:**	**110**

NUMBER OF PAGES: 15 PAGES

<u>INSTRUCTIONS</u>

Answer all the questions.

Calculators are permitted.

Answer SECTION A on UJ multiple choice answer sheet provided.

Answer SECTION B in the answer book provided.

SECTION A

1. A sailboat leaves a harbour and sails 1.1 km in the direction 75° north of east, where the captain stops for lunch. A short time later, the boat sails 1.8 km in the direction 15° south of east. What is the magnitude of the resultant displacement?

   A. 2.1 km
   B. 1.5 km
   C. 2.9 km
   D. 1.2 km
   E. 0.59 km

2. A jogger runs 10.0 blocks due east, 5.0 blocks due south, and another 2.0 blocks due east. Assume all blocks are of equal size. Determine the magnitude of the jogger's net displacement.

   A. 11 blocks
   B. 13 blocks
   C. 17 blocks
   D. 21 blocks

3. A quarterback takes the ball from the line of scrimmage and runs backward for 10 m. He then runs sideways, parallel to the line of scrimmage, for 15 m. Next, he throws the ball forward 50 m, perpendicular to the line of scrimmage. The receiver is tackled immediately. How far is the football displaced from its original position?

   A. 23 m
   B. 33 m
   C. 43 m
   D. 53 m

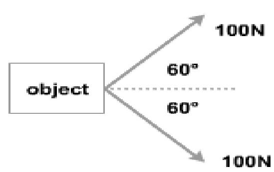
4. Vector **A** is 3.2 m in length and points along the positive *y*-axis. Vector **B** is 4.6 m in length and points along a direction 195^0 counterclockwise from the positive *x*-axis. What is the magnitude of the resultant when vectors **A** and **B** are added?

   A. 2.9 m
   B. 3.9 m
   C. 4.9 m
   D. 5.9 m

5. An hockey puck travels 2.00 m at 10.0^0 east of south before ricocheting 2.50 m at 75.0° north of east. What is the puck's resultant displacement?

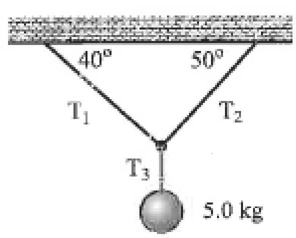
   A. 1.09 m at 24^0 north of east
   B. 1.09 m at 24^0 south of east
   C. 1.09 m at 24^0 east of north
   D. 1.09 m at 24^0 east of south

6. Two forces of value 100 N act on the object as shown below. Determine the resultant force on the object.



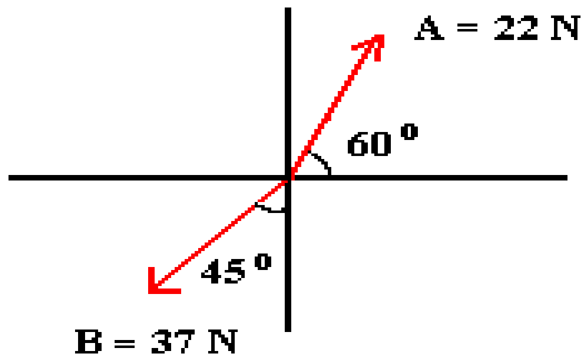
   A. 100 N at 60^0 to either force
   B. 120 N at 60^0 to either force
   C. 130 N at 60^0 to either force
   D. 150 N at 60^0 to either force

7. Determine the tension in each cord for the system shown below.



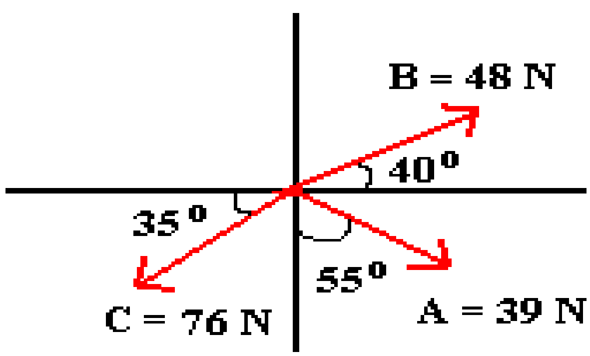
   A. T_1 = 31.5 N, T_2 = 37.5 N, T_3 = 49 N
   B. T_1 = 37.5 N, T_2 = 31.5 N, T_3 = 49 N
   C. T_1 = 31.5 N, T_2 = 49 N, T_3 = 37.5 N
   D. T_1 = 49 N, T_2 = 37.5 N, T_3 = 31.5 N

8. Determine the resultant of the vectors shown in the figure below.



A. R = 16.74 N at 205^o
B. R = 16.74 N at 105^o
C. R = 16.74 N at 305^o
D. R = 16.74 N at 150^o

9. Determine the resultant of the vectors shown in the figure below.



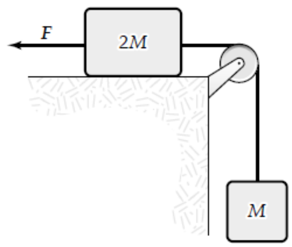
A. R = 35.7 N at 180.4^o
B. R = 35.7 N at 280.4^o
C. R = 45.7 N at 280.4^o
D. R = 55.7 N at 280.4^o

10. A block slides on a frictionless 20° inclined plane. A force of 16 N acting parallel to the incline and up the incline is applied to the block. What is the acceleration of the block?

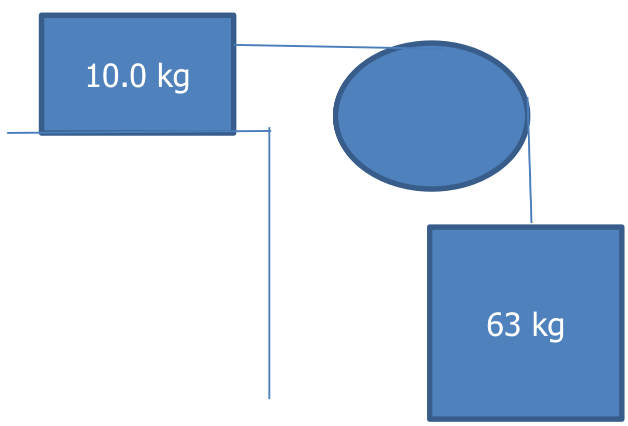
A. 2.0 ms^{-2} down the incline
B. 5.3 ms^{-2} up the incline
C. 2.0 ms^{-2} up the incline
D 3.9 ms^{-2} down the incline
E. 3.9 ms^{-2} up the incline

11. If F = 40 N and M = 1.5 kg, what is the tension in the string connecting M and $2M$? Assume that all surfaces are frictionless.

A. 13 N
B. 23 N
C. 36 N
D. 15 N
E. 28 N

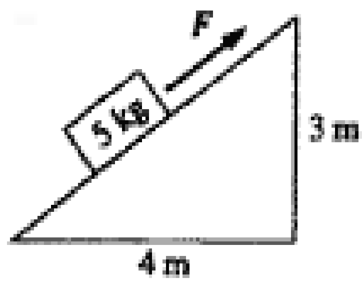


12. A 10.0 kg block on a table is connected by a string to a 63 kg mass, which is hanging over the edge of the table as shown below. Assuming that frictional forces may be neglected, what is the magnitude of acceleration of the 10.0 kg block when the other block is released?



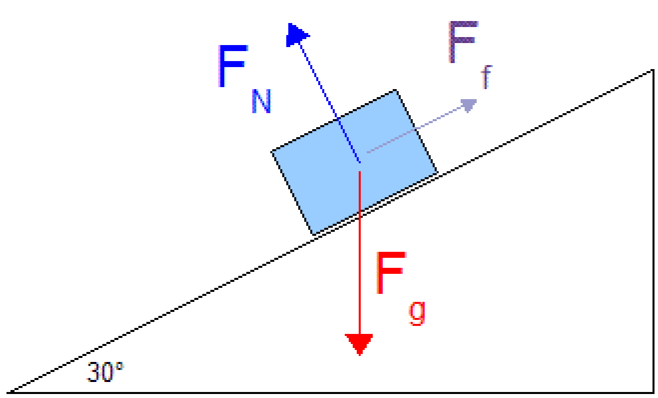
A. 8.5 ms^{-2}
B. 9.0 ms^{-2}
C. 8.1 ms^{-2}
D. 7.5 ms^{-2}

13. A block of mass 5 kg lies on an inclined plane as shown. The horizontal and vertical supports for the plane have lengths of 4 m and 3 m, respectively. The coefficient of friction between the plane and the block is 0.3. The magnitude of the force F necessary to pull the block up the plane with a constant speed is most nearly:



A. 30 N
B. 41 N
C. 49 N
D. 50 N
E. 58 N

14. Determine the acceleration of a 15 kg box down a 30° slope as shown below if the coefficient of friction is 0.15.



A. $a = 1.6\ ms^{-2}$
B. $a = 2.6\ ms^{-2}$
C. $a = 3.6\ ms^{-2}$
D. $a = 4.6\ ms^{-2}$

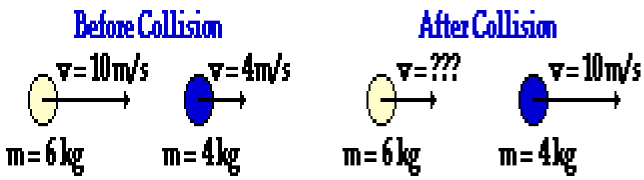
15. A projectile is fired from a cannon horizontally from edge of a 125 m cliff at 275 ms^{-1}. How far from the bottom of the cliff does the projectile land?

A. 125 m
B. 275 m
C. 550 m
D. 1390 m
E. 6880 m

16. A ball is thrown downward with an initial speed of 25 ms^{-1}. It strikes the ground after 2 seconds. How high is the building?

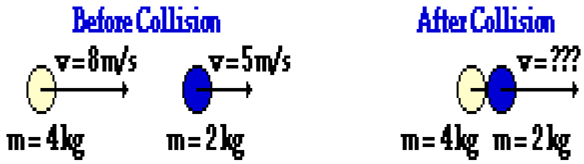
A. 20m
B. 30 m
C 50 m
D. 70 m
E. 80 m

17. Determine the unknown velocity value in the system shown below. Assume that the collisions occur in an isolated system.



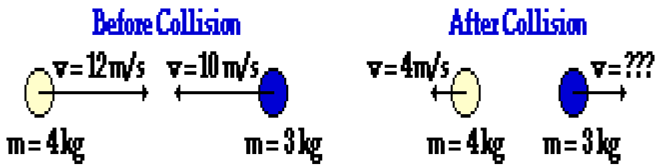
A. 2 ms^{-1}
B. 4 ms^{-1}
C. 6 ms^{-1}
D. 8 ms^{-1}

18. Determine the unknown velocity value in the system shown below. Assume that the collisions occur in an isolated system.



A. 1 ms^{-1}
B. 3 ms^{-1}
C. 5 ms^{-1}
D. 7 ms^{-1}

19. Determine the unknown velocity value in the system shown below. Assume that the collisions occur in an isolated system.



A. 11.3 ms^{-1}
B. 13.3 ms^{-1}
C. 15.3 ms^{-1}
D. 17.3 ms^{-1}

20. A ball is dropped from a window 19.6 m above the street level. Neglect air resistance. Determine the velocity at which it hits the ground.

A. 19.6 ms^{-1}
B. 29.6 ms^{-1}
C. 39.6 ms^{-1}
D. 49.6 ms^{-1}

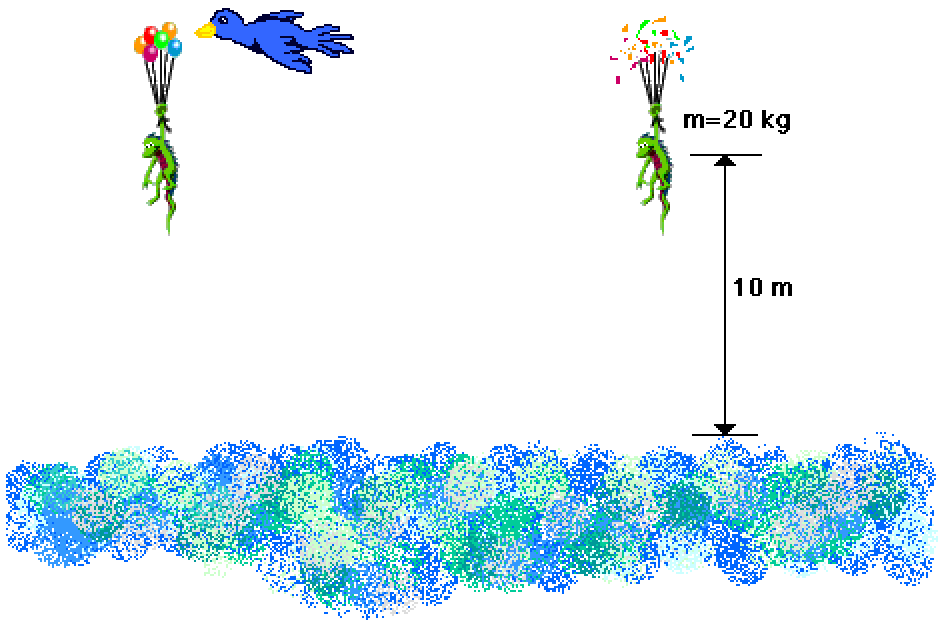
21. How high will a 30 kg object travel after it is released if it is released with a vertical velocity of 2.0 ms^{-1}?

A. h = 0.2 m
B. h = 0.4 m
C. h = 0.6 m
D. h = 0.8 m

22. How much power is present when a force of 500 N is applied to an object with a mass of 100 kg that is moving at 6 ms^{-1}?

A. 1000 W
B. 2000 W
C. 3000 W
D. 4000 W

23. Dino Dude is peacefully floating over the water when a big blue bird pops his balloons, causing Dino Dude to fall 10 m before crashing into the water. If Dino Dude has a mass of 20 kg, what is his velocity immediately before impact with the water?



A. 12 ms^{-1}
B. 14 ms^{-1}
C. 16 ms^{-1}
D. 18 ms^{-1}

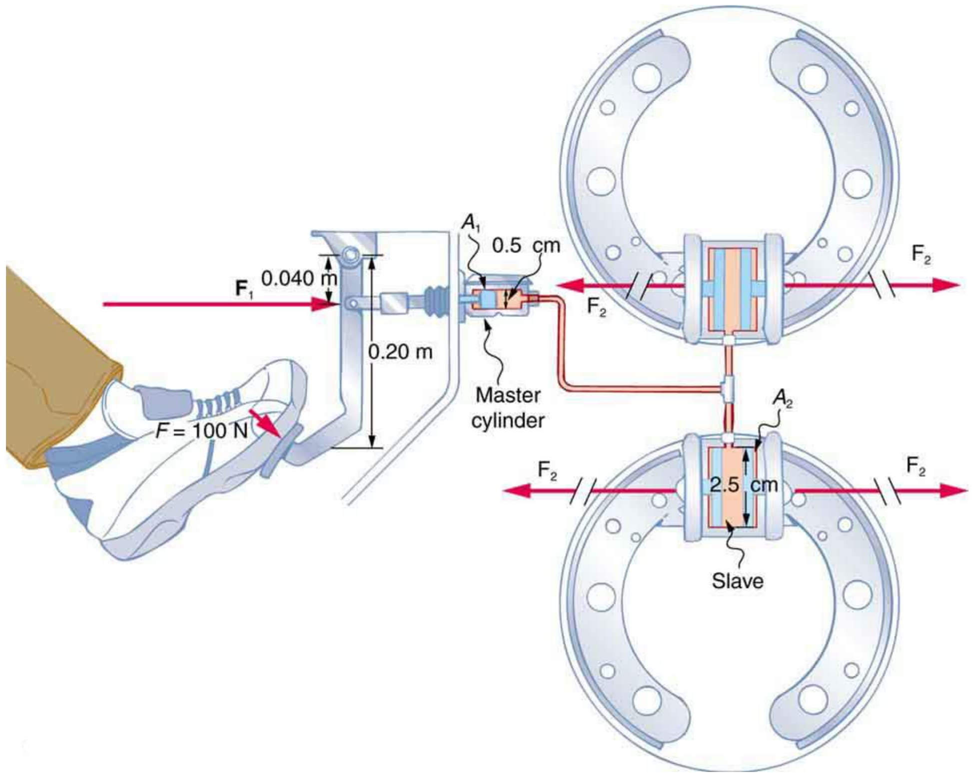
24. Calculate the time taken by a water pump of power 500 W to lift 2000 kg of water to a tank, which is at a height of 15 m from the ground?

A. 200 s
B. 400 s
C. 500 s
D. 600 s

25. A 500 N weight sits on the small piston of a hydraulic machine. The small piston has an area of 2 cm^2. If the large piston has an area of 40 cm^2, how much weight can the large piston support?

A. 25 N
B. 500 N
C. 10000 N
D. 40000 N

26. A force of 100 N is applied to the brake pedal, which acts on the cylinder called the master through a lever as shown below. A force of 500 n is exerted on the master cylinder. Pressure created ion the master cylinder is transmitted to four so-called slave cylinders. The master cylinder has a diameter of 0.5 cm, and each slave cylinder has a diameter of 2.5 cm. Calculate the force F2 created at each of the slave cylinders.

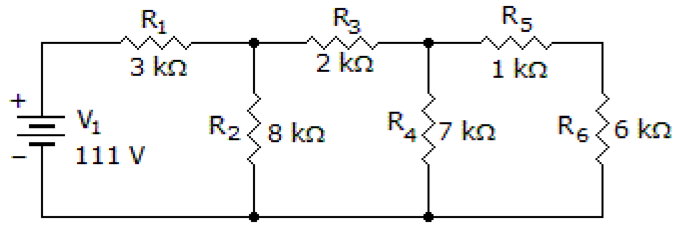


A. 1.25×10^4 N
B. 2.25×10^4 N
C. 3.25×10^4 N
D. 25×10^4 N

27. A liquid has a specific gravity of 0.357. What is its density?

A. 357 kgm^{-3}
B. 643 kgm^{-3}
C. 1000 kgm^{-3}
D. 3570 kgm^{-3}

28. What is the power dissipated by R_2, R_4, and R_6 in the circuit shown below?



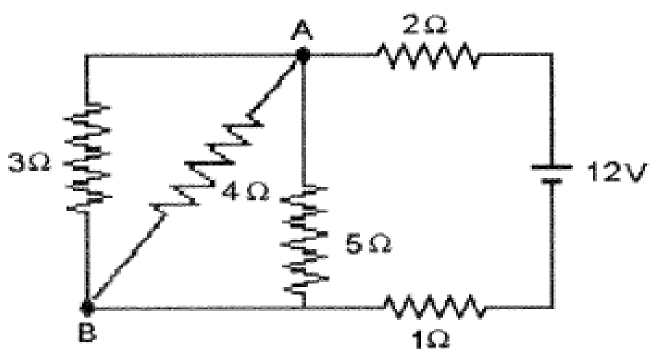
A. P_2 = 417 mW, P_4 = 193 mW, P_6 = 166 mW

B. P_2 = 407 mW, P_4 = 183 mW, P_6 = 156 mW

C. P_2 = 397 mW, P_4 = 173 mW, P_6 = 146 mW

D. P_2 = 387 mW, P_4 = 163 mW, P_6 = 136 mW

29. What is the current in the 1Ω resistor in the circuit shown below?



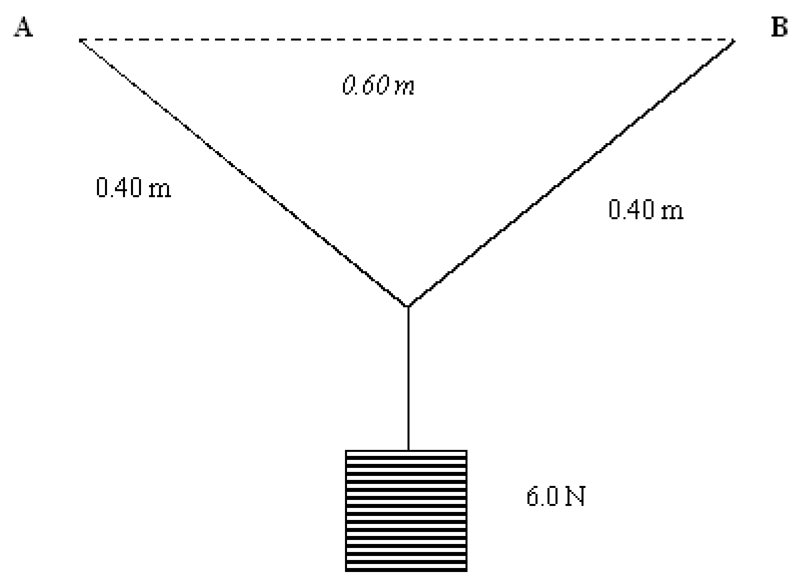
A. 0.90 A
B. 1.2 A
C. 2.8 A
D. 3.2 A
E. 4.2 A

[29 x 2 = 58]

SECTION B

QUESTION 1

1.1 A 6.0 N weight is attached to a light string which is then tied to the midpoint of a second string of length 0.8 m. This string is suspended from two fixed points which are on the same horizontal line 0.60 m apart. The arrangement is shown below.



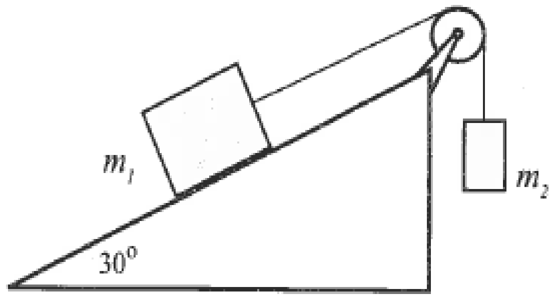
1.1.1 What is the angle between the two halves of the string? (3)

1.1.2 What is the tension in each half of the string? (6)

[9]

QUESTION 2

2.1 A block of mass m_1 = 3.70 kg on a frictionless inclined plane of angle θ = 30.0^0 is connected by a cord over a massless, frictionless pulley to a second block of mass m_2 = 2.30 kg hanging vertically as shown below.

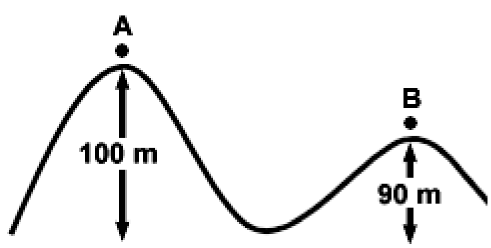


2.1.1 What is the acceleration of each block? (4)
2.1.2 What is the direction of the acceleration of m_2? (1)
2.1.3 What is the tension in the cord? (4)

[9]

QUESTION 3

3.1 A skier glides down a frictionless hill of 100 meters and then ascends another hill of height 90 meters, as shown in the figure below. What is the speed of the skier when it reaches the top of the second hill? (3)



3.2 A skier starts from rest at the top of a 45 m hill, skies down a 30º incline into a valley, and continues up a 40 m hill. Both hills are measured from the valley floor. Assume you can neglect friction.

3.2.1 How fast is the skier moving at the bottom of the valley? (3)
3.2.2 What is the skier's speed at the top of the next hill? (3)

3.3 A car weighing 1000 kg and travelling at 30 ms^{-1} stops at a distance of 50 m decelerating uniformly. What is the force exerted on it by the brakes? What is the work done by the brakes? (6)

[15]

QUESTION 4

4.1 State Archimedes' principle (1)

4.2 The weight of a man is 690N which contains 5.3×10^{-3} m^3 of blood.

3.2.1 Determine blood's weight. Take density of blood as 1060 kg/m^3 (2)

3.2.2 Express blood's weight as a percentage of body weight. (2)

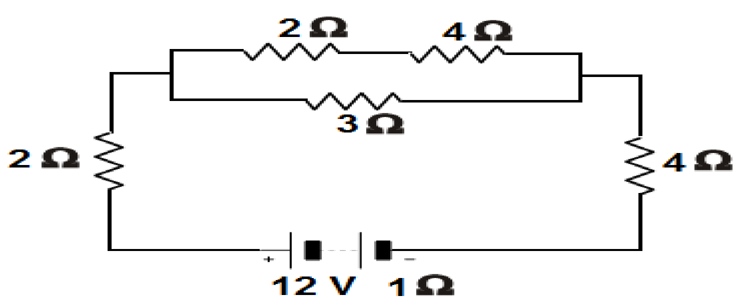
4.3 A golden-coloured cube is handed to you. The person wants you to buy it for \$100, saying that is a gold nugget. You pull out your old geology text and look up gold in the mineral table, and read that its density is 19.3 g/cm^3. You measure the cube and find that it is 2 cm on each side, and weighs 40 g. Density gold is 19.3g/cm^3 .What is its density? Is it gold? Should you buy it? (4)

[9]

QUESTION 5

5.1 State Ohm's law. (1)

5.2 Five resistors are connected to a battery with an emf of 12 V and an internal resistance of 1 Ω.



5.2.1 Calculate the external resistance of the circuit. (4)
5.2.2 Calculate the current in the battery. (2)
5.2.3 Calculate the terminal voltage of the battery. (2)
5.2.4 Calculate the power dissipation in the 3Ω resistor. (3)
5.2.5 Calculate the power dissipation in the internal resistance. (2)

[14]