UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

MODULE PHYSICS I FWFJA14

CAMPUS DFC

NOVEMBER EXAMINATION 2014

DATE: 10/11/2014 **SESSION: 08:30 - 11:30**

ASSESSOR **DR S.P. BVUMBI**

INTERNAL MODERATOR **MR T.G. MATHE**

DURATION: 3 HOURS **MARKS: 115**

NUMBER OF PAGES: 12 PAGES INCLUDING FORMULA SHEET

INSTRUCTIONS

Answer all the questions.

Calculators are permitted.

Answer SECTION A on UJ multiple choice grid provided.

Answer SECTION B in the answer book provided.

SECTION A

1. A car accelerates at 2 m s^{-2}. Assuming the car starts from rest, how much time does it need to accelerate to a speed of 20 m s^{-1}?

   A. 2 seconds
   B. 10 seconds
   C. 20 seconds
   D. 40 seconds
   E. none of the above

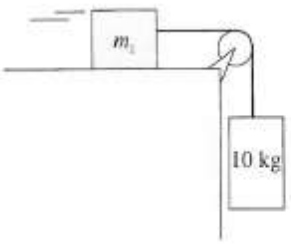
2. A freely falling object starts from rest. After falling for 6 seconds, it will have a speed of

   A. 6 m s^{-1}
   B. 30 m s^{-1}
   C. 60 m s^{-1}
   D. 300 m s^{-1}
   E. more than 300 m s^{-1}

3. How far will a brick starting from rest fall freely in 3.0 seconds?

   A. 15 m
   B. 29 m
   C. 44 m
   D. 88 m

4. If the tension in the line joining the two masses shown below is 12 N, what is the mass, m_1? Ignore surface friction.



   A. 1.1 kg
   B. 1.4 kg
   C. 2.0 kg
   D. 10 kg

5. A 100 W light bulb is left on for 10.0 hours. Over this period of time, how much energy was used by the bulb?

A. 1 000 J
B. 3 600 J
C. 3 600 000 J
D. 1.34 hp

6. How much work must be done to stop a 1 800 kg vehicle travelling at 30 m s^{-1}?

A. 1.8×10^4 J
B. 5.4×10^4 J
C. 5.3×10^5 J
D. 8.1×10^5 J

7. Pascal's principle states that when a force is applied to a confined fluid, the change in pressure is transmitted

A. only to the area where the pressure is applied
B. equally to all parts of the fluid
C. to any weakness in the fluid's container
D. in the direction of the buoyant force

8. How much pressure do you experience when you balance a 5 kg ball on the tip of your finger, which has an area of 1 cm^2?

A. 490 kPa
B. 590 kPa
C. 690 kPa
D. 790 kPa

9. 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

10. A liquid has a relative density of 0.357. What is its density?

A. 357 kg/m^3
B. 643 kg/m^3
C. 1000 kg/m^3
D. 3570 kg/m^3

11. The mass of a relative density bottle is 1.5 kg when empty, 24 kg when filled with water and 30 kg when filled with glycerine. Determine the relative density of glycerine.

A. 1.27
B. 2.27
C. 3.27
D. 1.47

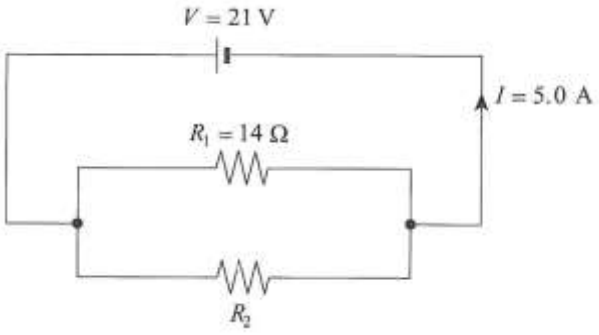
12. A 15 000 N car on a hydraulic lift rests on a cylinder with a piston of radius 0.20 m. If a connecting cylinder with a piston of 0.040 m radius is driven by compressed air, what force must be applied to this smaller piston in order to lift the car?

A. 600 N
B. 1 500 N
C. 3 000 N
D. 15 000 N

13. If the column of mercury in a barometer stands at 72.6 cm, what is the atmospheric pressure? (The density of mercury is 13.6×10^3 kg/m^3 and g = 9.80 m/s^2)

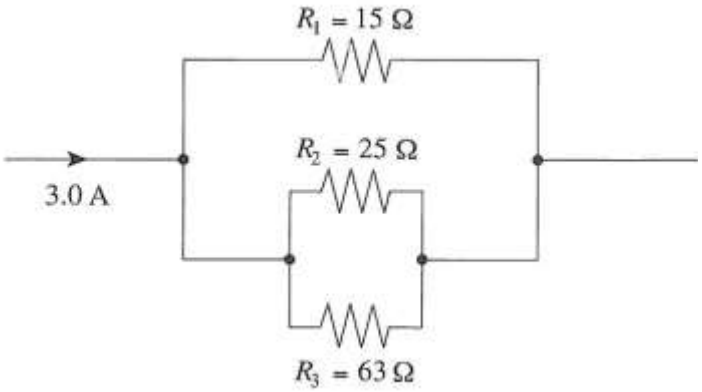
A. 0.968×10^5 Pa
B. 1.03×10^5 Pa
C. 0.925×10^5 Pa
D. 1.07×10^5 Pa

14. Determine the current through resistor R_2 in the circuit shown below.



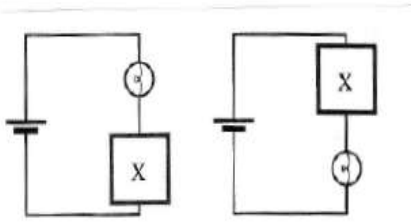
A. 1.5 A
B. 2.5 A
C. 3.5 A
D. 5.0 A

15. The diagram below shows part of an electric circuit. What is the current through resistor R_1?



A. 1.0 A
B. 1.4 A
C. 1.6 A
D. 3.0 A

16. In which of the two circuits shown below, is the bulb brighter?



A. Left picture
B. Right picture
C. Both the same
D. Need more information

17. How much power is used by a 12.0 V car battery that draws 0.5 A of current?

A. 0.5 W
B. 6 W
C. 12 W
D. 24 W
E. 30 W

18. When plugged into a 120 V wall outlet, how much current is used by an electric blanket rated at 140 W?

A. 16 800 A
B. 140 A
C. 120 A
D. 1.2 A

19. A steel wire, 150 m long at 10°C, has a coefficient of linear expansion of 11×10^{-6}/C°. Calculate its change in length as the temperature changes from 10°C to 45°C.

A. 0.65 cm
B. 1.8 cm
C. 5.8 cm
D. 12 cm

20. An object is situated between a concave mirror's surface and its focal point. The image formed in this case is

A. virtual and erect
B. real and inverted
C. real and erect
D. virtual and inverted

[20 x 2 = 40]

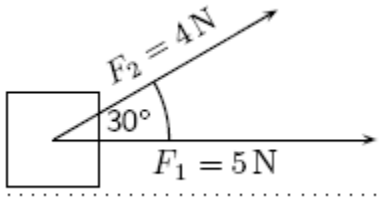
SECTION B

QUESTION 1

1.1 Define the following:

1.1.1 Resultant vector (2)
1.1.2 Equilibrant (2)

1.2 A force F_1 = 5 N is applied to a block in a horizontal direction. A second force F_2 = 4 N is applied to the object at angle of 30^0 above the horizontal as shown in the diagram below. Determine the magnitude and direction of the resultant force acting on the block. (6)



1.3 A motorist undergoes a displacement of 250 km in a direction 30 º north of east. Resolve this displacement into components in directions north and east. (4)

[14]

QUESTION 2

2.1 Define the following:

2.1.1 Acceleration (2)

2.1.2 Speed (2)

2.2 A body with initial velocity 8 m s^{-1} moves with a constant acceleration and travels 640 m in 40 s. Calculate:

2.2.1 The average velocity during the 40 s interval (3)

2.2.2 The final velocity (3)

2.2.3 The acceleration (4)

[14]

QUESTION 3

3.1 State two differences between weight and mass. (2)

3.2 State Newton's second law of motion (2)

3.3 What constant unbalanced force acting on a body, 30 kg, will:

3.3.1 give it an acceleration of 3 cm s^{-2}? (3)

3.3.2 give it a speed of 8 m s^{-1} in 6 s from rest? (3)

3.3.3 change its speed from 20 m s^{-1} to 10 m s^{-1} in passing through a distance of 25 m? (4)

[14]

QUESTION 4

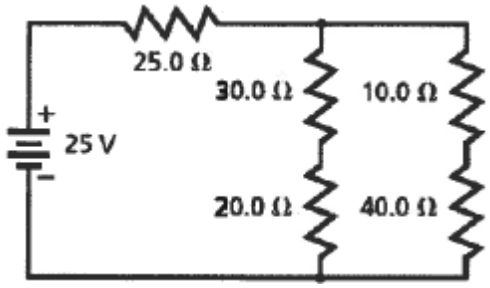
4.1 State Archimedes' principle. (2)

4.2 The mass of a marble in air is 30 g, in water 25 g and in alcohol 27g. Calculate the relative density of alcohol. (4)

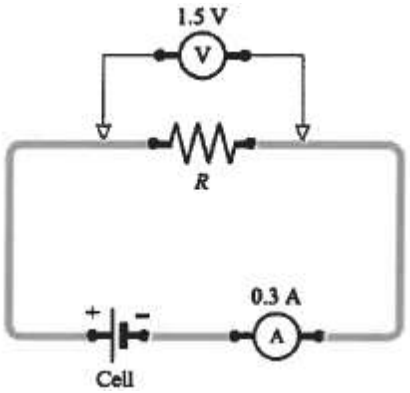
[06]

QUESTION 5

5.1 Calculate the total resistance of the circuit and the current through the 25.0 Ω resistor in the circuit shown below. (6)



5.2 Determine the value of resistor R in circuit shown below. Assume that the voltmeter and ammeter are perfect. (3)



[09]

QUESTION 6

6.1 State the Law of conservation of heat. (2)

6.2 A large block of ice at 0 ºC has a hole drilled into it and 400 g of aluminium pellets at a temperature of 30 ºC are poured into the hole. How much (in grams) of the ice melts? (4)

[06]

QUESTION 7

7.1 State Boyle's Law (2)

7.2 An enclosed gas has a volume of 100 cm^3 when the pressure is 650 mm Hg. At what pressure (in mm Hg) will the volume be 125 cm^3 if the temperature remains constant? (4)

7.3 One way to cool a gas is to let it expand. Typically, a gas at 27 ºC and a pressure of 40 atm might be expanded to atmospheric pressure and volume 13 times larger. Determine the new temperature (in ºC) of the gas. (6)

[12]