UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

NATIONAL DIPLOMA IN: BIOMEDICAL TECHNOLOGY

MODULE: PHY1AET
PHYSICS 1B

CAMPUS DFC

JUNE EXAMINATION

DATE: 19/06/2014	**SESSION 12:30 – 15:30**
ASSESSOR(S)	**DR P L MASITENG**
INTERNAL MODERATOR	**DR S RAMAILA**
DURATION 3 HOURS	**MARKS 121**

NUMBER OF PAGES: 14 PAGES, INCLUDING 2 INFORMATION SHEETS

INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)

REQUIREMENTS: 1 MULTIPLE CHOICE ANSWER SHEET.

INSTRUCTIONS TO CANDIDATES

1. **THIS QUESTION PAPER CONSISTS OF 2 SECTIONS.**
   ANSWER SECTION A ON THE OPTICAL ANSWER SHEET PROVIDED.
   FOLLOW THE INTRUCTIONS ON THE ANSWER SHEET CAREFULLY.
   IF YOU MAKE A MISTAKE PLEASE REQUEST A NEW ANSWER SHEET.
   DO NOT MARK MORE THAN ONE ANSWER. PLACE THE ANSWER SHEET IN THE ANSWER BOOK. DO NOT FOLD OR CREASE THE ANSWER SHEET IN ANY WAY!
2. **ANSWER SECTION B IN THE ANSWER BOOK PROVIDED.**
3. **AN INFORMATION SHEET IS ATTACHED**
4. **ANSWER ALL THE QUESTIONS.**

SECTION A –MULTIPLE CHOICE

QUESTION 1

1. Refractive index is defined as

   A. $\dfrac{\text{real depth}}{\text{apparent depth}}$

   B. the change in direction of a light ray as it travels from one optical medium into another

   C. $\dfrac{\text{velocity of light in medium 1}}{\text{velocity of light in medium 2}}$

   D. $\dfrac{\text{sin (angle of incidence)}}{\text{sin (angle of refraction)}}$

2. The image of an object placed in front of a convex mirror is:

   A. Inverted and real depending on the distance of the object from the mirror.
   B. Erect and virtual depending on the distance of the object from the mirror.
   C. Real, inverted and enlarged in size.
   D. Erect, virtual, and diminished in size.

3. An object is placed 15 cm from a convex mirror of focal length 10 cm.
   The distance between the object and the image is:

   A. 30 cm
   B. 25 cm
   C. 21 cm
   D. 6 cm

3\...

4. The magnification produced by the convex mirror in question 3 is:

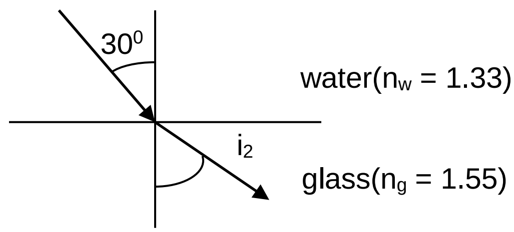
A. 1.4
B. 0.7
C. 1.7
D. 0.4

5. An erect image, two times the size of the object, is obtained with a concave mirror of radius of curvature 18 cm. The position of the object from the mirror is:

A. 9 cm
B. 4.5 cm
C. 13.5 cm
D. 18 cm

6. A ray of light is incident in water at an angle of 30^0 on a water-glass plane surface as shown in a diagram. The angle of refraction in the glass is:

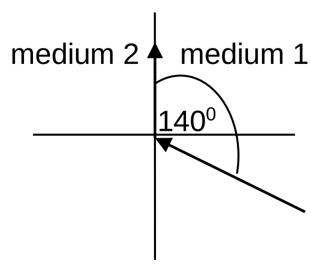
A. 34.3^0
B. 77.3^0
C. 47.9^0
D. 24.5^0



7. What is the apparent position of an object below a rectangular block of glass 6 cm thick if a layer of water 4 cm deep is on top of the glass with the refractive index of glass and water being 3/2 and 4/3 respectively.

A. 4 cm
B. 3 cm
C. 7 cm
D. 2 cm

8. Light travels from medium 1 to medium 2 as shown.
The critical angle between the mediums is:



A. 50^0
B. 40^0
C. 90^0
D. 140^0

9. The relative refractive index of medium 1 with respect to 2 in question 8 is:

A. 1.6
B. 0.7
C. 1.3
D. 0.9

10. The straight line path length of a body's change in position in a specific direction is known as:

A. distance
B. vector
C. displacement
D. scalar

11. A body of mass m is at rest. Its velocity changes to v in a time t.

The expression $\frac{mv}{t}$ represents:

A. the acceleration of the body
B. the displacement of the body
C. the force exerted on the body
D. the velocity of the body

12. If a train travelling at 72 km h^{-1} undergoes a uniform deceleration of 2 m s^{-2} when brakes are applied, the time taken for the train to come to rest will be:

A. 10 s
B. 2 s
C. 20 s
D. 72 s

13. What will be the distance travelled by the train in question 12 from the place where the brakes were applied?

A. 34 m
B. 44 m
C. 72 m
D. 100 m

14. A 50 g golf ball strikes a wall and undergoes a change in velocity of 10 m s^{-1}.
The impulse on the wall is:

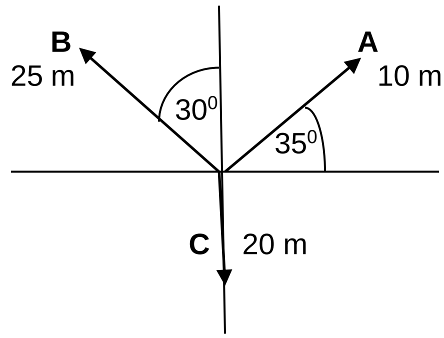
A. 0.5 N s
B. 500 N s
C. 50 N s
D. 5 N s

5\...

15. A component of a vector in a given direction is defined as:

A. that force that keeps the other forces in equilibrium
B. that single vector that has the same effect as the other vectors together
C. the vector closing a vector polygon
D. the effective magnitude of the vector in that direction

Questions 16 to 19 refer to the sketch shown of a body which undergoes three displacements at the given angles:



16. The resultant X component, R_x, of the three vectors shown is:

A. 29.8 m
B. – 4.3 m
C. 20.7 m
D. 13.2 m

17. The resultant y-component, R_y, is:

A. 18.2 m
B. 38.2 m
C. 7.4 m
D. 29.8 m

18. The magnitude of the resultant displacement is:

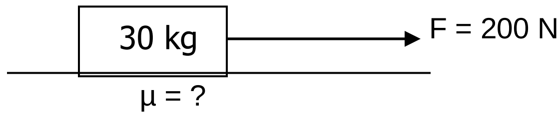
A. 8.6 m
B. 10.7 m
C. 11.9 m
D. 3.1 m

19. The direction of the resultant displacement is:

A. 31.4^0 N of E
B. 59.8^0 N of W
C. 77.1^0 N of W
D. 61.5^0 N of E

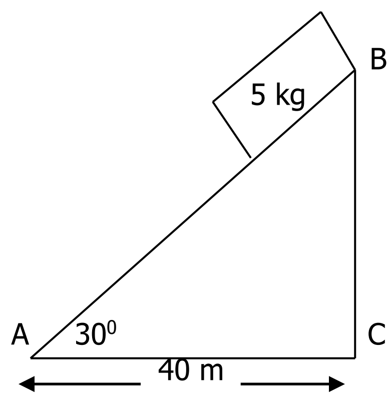
20. A 30 kg mass accelerates at 0.5 m s^{-2} in the direction of the force as shown. The coefficient of friction between the body and the surface is:

A. 0.63
B. 0.01
C. 0.43
D. 0.34



21. A body of mass 5 kg slides from rest down a frictionless incline from B to A, 40 m from C, as shown. The potential energy of the body at B is:

A. 1 131.6 J
B. 1 922.8 J
C. 2 401 J
D. 2 250 J



22. The velocity of the body at A in question 21 will be:

A. 31 m s^{-1}
B. 21.3 m s^{-1}
C. 27.7 m s^{-1}
D. 30 m s^{-1}

23. A ball is thrown vertically upward and is caught again at the same height after a time of 5.1 s. The velocity with which it was thrown upward is:

A. 25 m s^{-1}
B. 10 m s^{-1}
C. 50 m s^{-1}
D. 12.5 m s^{-1}

24. An object is dropped from a 300 m high cliff. After falling for a time of 4 s, its height above the ground will be:

A. 78.4 m
B. 221.6 m
C. 150 m
D. 12.5 m

25. A cube of gold has a mass of 520 g. If gold has a density of 19 300 kg m^{-3}, the side length of the cube measures:

A. 3 cm
B. 5 cm
C. 7 cm
D. 9 cm

26. The mass of an RD bottle filled with water is 200 g, whilst filled with oil of relative density 0.8 the mass is 170 g. The mass of the empty bottle is:

A. 50 g
B. 94 g
C. 24 g
D. 30 g

27. 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

28. A steel ring of 3 cm inside diameter at 20 ^{0}C is to be heated and slipped over a brass shaft measuring 3.002 cm in diameter at 20 ^{0}C. To what temperature should the ring be heated?

A. 15.6 ^{0}C
B. 80.6 ^{0}C
C. 70.6 ^{0}C
D. 60.6 ^{0}C

29. The pascal is defined as:

A. that force acting over a 1 m^2 area
B. a force of 1 N acting over a 1 m^2 area
C. the pressure exerted by a 1 N force acting uniformly and perpendicular over a 1 m^2 area
D. the pressure being equally and undiminished transmitted throughout a confined fluid should a change in pressure be applied to it.

30. A flexible rubber balloon contains air at a pressure of 0.91 m of mercury and a temperature of 20 ^{0}C. The balloon is immersed in boiling water at 100 ^{0}C and its volume increases by 15 %. The pressure of the air at 100 ^{0}C in kPa is:

A. 207.33 kPa
B. 100.56 kPa
C. 120.87 kPa
D. 1 029.4 kPa

8\...

31. A litre of gas has a pressure of 100 kPa at a temperature of – 20 ^{0}C. If the gas is compressed to 0.5 litre and the temperature is raised to 40 ^{0}C, what will be the gas pressure?

A. 247.23 kPa
B. 200.89 kPa
C. 111.23 kPa
D. 342.32 kPa

32. A body of weight 12 N floats in oil of relative density 0.8. The mass of oil displaced is:

A. 15 kg
B. 9.6 kg
C. 122 kg
D. 1.22 kg

33. A 2 m long silver rod expands by 2 mm when heated by 200 ^{0}C. The volumetric expansivity of silver is:

A. 0.0015 $^0C^{-1}$
B. 0.15 x 10^{-6} $^0C^{-1}$
C. 1.5 x 10^{-5} $^0C^{-1}$
D. 5 x 10^{-6} $^0C^{-1}$

34. Specific heat capacity is defined as the heat exchanged

A. during a phase change without a change in temperature
B. during a phase change of 1 kg of a substance without a temperature change
C. by a 1 kg of a substance for a 1 K temperature change
D. by a substance to change its temperature by 1 K.

35. Two resistors of 10 Ω and **x** Ω are connected in parallel. The equivalent resistance is 8 Ω. The value of **x** is (in Ω):

A. 4.4
B. 40
C. 2
D. 19

36. The kilowatt-hour is used to measure:

A. electrical power
B. electrical current
C. electrical energy
D. electrical potential difference.

37. Ohm's law states that the potential difference across a conductor

    A. is equal to the current times the resistance
    B. is directly proportional to the current as well as the resistance
    C. at constant temperature is inversely proportional to the resistance but directly proportional to the current
    D. at constant temperature is directly proportional to the current, provided the conductor is metallic.

38. The resistance of the heating element of an electric heater is 55 Ω. When the heater is connected to a 220 V supply, the rate at which energy is dissipated is:

    A. 880 W
    B. 900 W
    C. 800 W
    D. 8 W

39. The power rating of an electrical heater is 2.2 kW. It is connected to a 220 V supply. The charge that will flow through it in a time of 5 hours is:

    A. 2.4×10^3 C
    B. 1.8×10^5 C
    C. 9×10^5 C
    D. 3×10^3 C

40. Two identical resistors in parallel have an equivalent resistance of 2 Ω. If the resistors are connected in series, their equivalent resistance will be:

    A. 8 Ω
    B. 16 Ω
    C. 4 Ω
    D. 2 Ω

Total section A: 2 x 40 = 80

SECTION B

QUESTION 1

1.1. Draw a ray diagram to show image formation by a concave lens. (3)

1.2. A concave mirror of focal length 10 cm forms a virtual image 2 times the size of an object placed in front of the mirror.

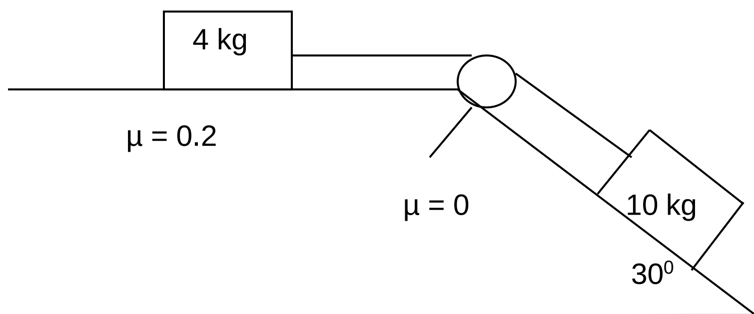
Calculate:

1.2.1. the object and
1.2.2. the image positions. (3)

[6]

QUESTION 2

2.1. Calculate the acceleration of the following system.



(6)
[6]

QUESTION 3

3.1 State the following:

3.1.1. Pascal's principle
3.1.2. Archimedes' principle (4)

3.2. A body of weight 6 N is suspended from a spring balance. The spring balance registers 4 N when the body is completely immersed in water. What weight will be registered on the balance when the body is completely immersed in a liquid of relative density 0.9 ? (4)

[8]

QUESTION 4

4.1. A copper beaker of mass 0.5 kg contains 1 kg of water at a temperature of 20 ^{0}C. A 0.55 kg block of copper at a temperature of t ^{0}C is dropped into the water and the temperature is observed to increase to 30 ^{0}C. Determine the temperature t. (4)

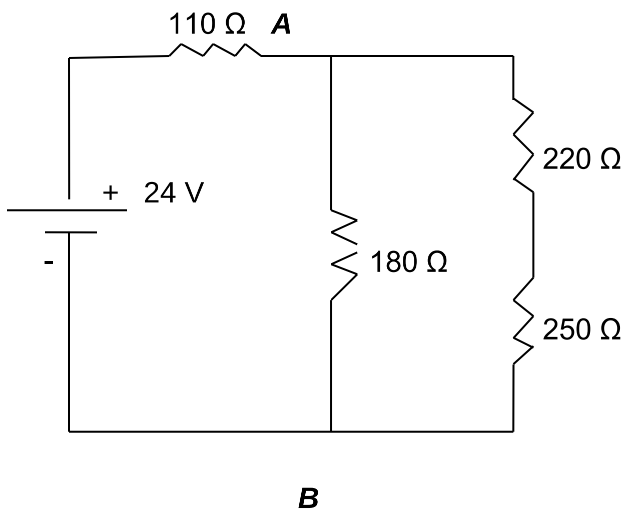
4.2. A steel pipe 125 m long is installed at 20 ^{0}C. Calculate the decrease in length when coolants at -20 ^{0}C pass through the pipe. The linear expansivity of steel is $11 \times 10^{-6}\ {}^0C^{-1}$. (3)

4.3 A beaker of negligible mass contains 500 g of water at 80 ^{0}C. Calculate what mass of water at 10 ^{0}C must be added to the water so that the final temperature of the system will be 50 ^{0}C. (5)

[12]

QUESTION 5

5.1. The figure below shows a circuit composed of a 24 V battery and four resistors, whose resistances are 110 Ω, 180 Ω, 220 Ω and 250 Ω.



Calculate:

5.1.1. the total current supplied by the battery (7)

5.1.2 . the voltage between points ***A*** and ***B.*** (2)

[9]

Total section B: 41

Grand Total: 121