POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MATHEMATICS, SCIENCE & COMPUTER DEPARTMENT

FINAL EXAMINATION

DECEMBER 2011 SESSION

BB101 : ENGINEERING SCIENCE

DATE : 24 APRIL 2012 (TUESDAY)
DURATION : 2 HOURS (8.30 AM – 10.30 AM)

This paper consists of **EIGHT (8)** pages including the front page and appendix.

This paper consists of **SIX (6)** questions. Answer **FOUR (4)** questions only

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DO NOT OPEN THIS QUESTION PAPER UNTIL INSTRUCTED BY THE CHIEF INVIGILATOR

(CLO stated at the end of each question is referring to the learning outcome of the topic assessed. The CLO stated is only for lectures' references.)

INSTRUCTION:

This paper consists of **SIX (6)** structured questions. Answer **FOUR (4)** questions only.

QUESTION 1

a) Define scalar quantity and give two examples.[CLO1] (3 marks)

b) Define speed, velocity and acceleration and state their SI units.[CLO1] (6 marks)

c) A car is accelerated at $8ms^{-2}$ from an initial velocity of $4ms^{-1}$ for 10 seconds. Calculate: [CLO3]

i. The final velocity. (3 marks)

ii. The distance travelled by the car. (4 marks)

d) A runner runs from the starting line and achieves a velocity of $20ms^{-1}$ in 2.6 seconds.[CLO3]

i. Calculate his acceleration. (2 marks)

ii. If the acceleration is constant, calculate the displacement traveled in 6.5 second. (2marks)

e) A car starting from rest accelerated uniformly to $63ms^{-2}$ over a period of 12 seconds. The car then maintained the velocity for 14 seconds. The velocity is then reduced uniformly to $30ms^{-1}$ in 9 seconds and finally brings to rest after another further 10 seconds. Draw a velocity-time graph for the whole journey of the car on a graph paper. [CLO3]

(5 marks)

QUESTION 2

a)

i. Give the definition of force and state its unit. [CLO1]

(3 marks)

iii. Give the definition of moment and state its unit. [CLO1]

(3 marks)

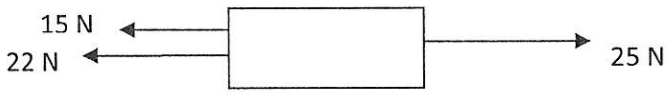
iii. State **THREE (3)** differences between weight and mass.[CLO1]

(3 marks)

b) State the definition for Newton's Second Law. [CLO1]

(2 marks)

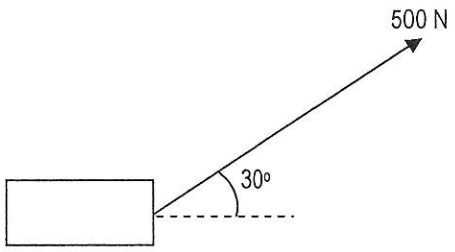
c) Find the resultant force for the following:[CLO3]



(1 mark)

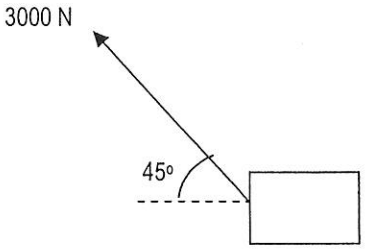
d) Calculate the horizontal and vertical components for the forces in the figures below: [CLO3]

i.



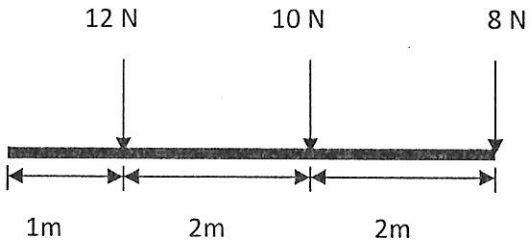
(4 marks)

ii.



(4 marks)

e) Determine the gravitational point to balance the bar below by using the moment force method. [CLO3]



(5 marks)

QUESTION 3

a) State the definition of the following terms and their SI units: [CLO1]

i. Work

(2 marks)

ii. Energy

(2 marks)

iii. Power

(2 marks)

b) State the kinetic energy of a 200g bus that is moving at a speed of $30.0ms^{-1}$. [CLO3]

(3 marks)

c) A pitcher throws a baseball of mass 145g with a speed of $20ms^{-1}$. What is its kinetic energy?[CLO3]

(3 marks)

d) A box of mass 5kg is placed on a shelf which is 0.2m above a table. If the table top is 0.5m above the floor as shown in **Figure 1**, find the potential energy of the box with reference to:[CLO3]

i. the table top

(2 marks)

ii. the floor

(2 marks)

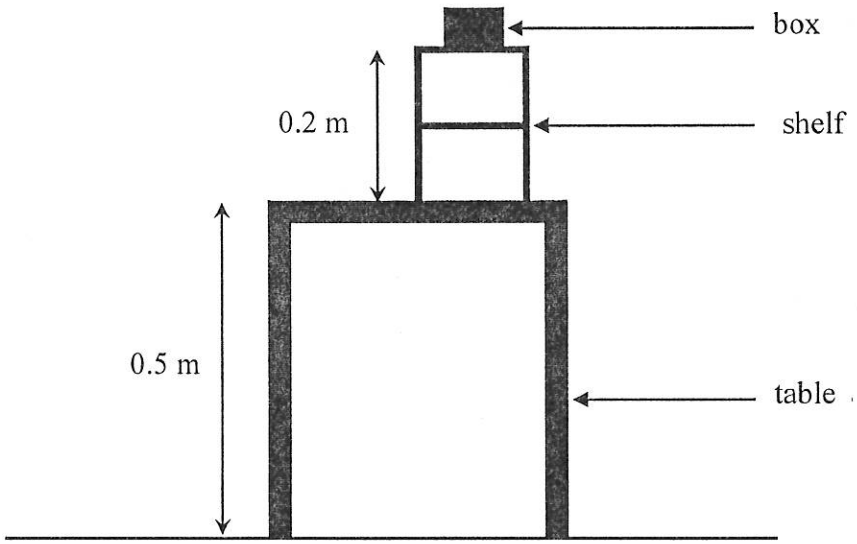


Figure 1

e) A car moves at a constant velocity of 72kmh^{-1}. Find the power generated by the car if the force of friction that acts on it is 1500N. [CLO3]

(4 marks)

f) A car with a mass of 2000kg moves with a constant velocity of 50 kmh^{-1}. The car suddenly brakes and stops within 15m. Calculate the work done to stop the car.[CLO3]

(5 marks)

QUESTION 4

a) State **THREE (3)** characteristics of each of the following:[CLO1]

i. Solid (3 marks)

ii. Liquid (3 marks)

iii. Gas (3 marks)

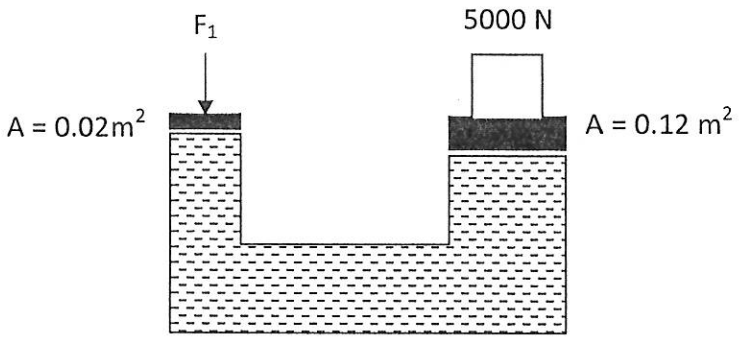
b) Define and state the SI units of the following terms:[CLO1]

i. Density (2 marks)

ii. Pressure (2 marks)

c) A metal cube of mass 40kg and surface area of $0.08m^2$ is placed on a floor. Determine the pressure exerted on the floor?[CLO3] (4 marks)

d) **Figure 2** shows a hydraulic lift with a force F_1 acting on a circular piston with an area of $0.02m^2$. The pressure generated is transmitted through a liquid to a second piston with area of $0.12m^2$. Calculate the minimum force F_1 which need to be applied so that a load of 5000N is lifted.[CLO3]



(3 marks)

Figure 2

e) An object floats in water with ¾ of its volume immersed under the water surface. Given that the density of water is $1gcm^{-3}$.Calculate the density of the object in kgm^{-3}. [CLO3]

(5 marks)

QUESTION 5

a) Define and state the SI unit of the terms below:[CLO1]

i. Heat (2 marks)

ii. Temperature (2 marks)

b) Describe the **THREE (3)** processes of how heat is transferred. [CLO1] (6 marks)

c) Calculate the amount of heat required to raise the temperature of 350g of copper from 37°C to 54°C. (Given that specific heat capacity of copper is $390 Jkg^{-1}°C^{-1}$) [CLO3] (3 marks)

d) Calculate the specific heat capacity of liquid Z if $2.7 \times 10^5 J$ amount of heat is needed to increase the temperature of 5.3kg of liquid Z from 21°C to 55°C. [CLO3] (3 marks)

e) M and N are two liquids. The mass of M is 5.2kg. Given that the specific heat capacity of M is 4.2×10^3 $Jkg^{-1}°C^{-1}$ and N is $3.3 \times 10^3 Jkg^{-1}°C^{-1}$. The initial temperature of M is 56°C and N is 23°C. Then, both liquids are mixed and the final temperature of the mixture is 39°C. Assume that no heat is lost to the surroundings.[CLO3]

i. What is the meaning of thermal equilibrium? (2 marks)

ii. Calculate the temperature difference of liquid M and N respectively after they are mixed. (2 marks)

iii. Calculate the mass of liquid N. (5 marks)

QUESTION 6

a) Define and state the SI units for the following terms: [CLO1]

i. Current (2 marks)

ii. Voltage (2 marks)

b) Calculate the total charge that flows through a point in an electric circuit when 5A of current passes in 3 minutes?[CLO3] (4 marks)

c) A 5.5A of current flows through a circuit with a voltage of 6V. Calculate the resistance in the circuit.[CLO3] (3 marks)

d)

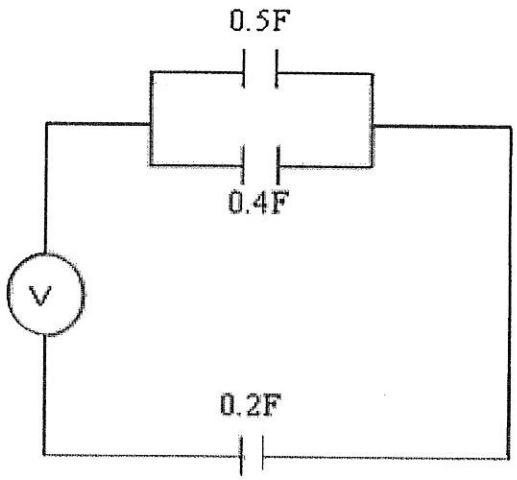


Figure 3

In **Figure 3**, three capacitors of 0.5F, 0.4F and 0.2F are connected in a circuit with a potential difference of 8V. Calculate:[CLO3]

i. the total capacitance of the circuit (4 marks)

ii. the total charge that flow in the circuit (4 marks)

e) A 4μF electrical charge flows through a capacitor in 0.5 minutes. If the total current that flows in the circuit is 5.2mA, how much energy is stored in the capacitor? [CLO3]

(6 marks)

BB101 (ENGINEERING SCIENCE) – FORMULA

1. $g = 9.81\ m/s^2$
2. $W = mg$
3. $v = u + at$
4. $s = ut + \frac{1}{2}at^2$
5. $s = \frac{1}{2}(u + v)t$
6. $v^2 = u^2 + 2as$
7. $F_y = F\sin\theta$
8. $F_x = F\cos\theta$
9. $F_R = \sqrt{(F_x)^2 + (F_y)^2}$
10. $\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right)$
11. $M = Fd$
12. $E_p = mgh$
13. $E_k = \frac{1}{2}mv^2$
14. $W = Fs$
15. $P = \frac{W}{t}$
16. $P = Fv$
17. $\rho = \frac{m}{v}$
18. $\rho_{relative} = \frac{\rho_{substance}}{\rho_{water}}$
19. $P = \frac{F}{A}$
20. $P = \rho gh$
21. Pascal's Principle, $\frac{F_1}{A_1} = \frac{F_2}{A_2}$
22. $F_B = \rho Vg$
23. $Q = mc\theta$
24. $c_{water} = 4{,}200\ J/kg^oC$
25. $\rho_{water} = 1{,}000\ kg/m^3$
26. $C = \frac{Q}{v}$
27. $R = \frac{\rho I}{A}$
28. $V = IR$
29. $Q = It$
30. $E_p = \frac{1}{2}CV^2$
31. R series, $R_T = R_1 + R_2 + R_3 + \ldots$
32. R parallel, $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$
33. C parallel, $C_T = C_1 + C_2 + C_3 + \ldots$
34. C series, $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots$