

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

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION  
DECEMBER 2011 SESSION

**JJ205 : ENGINEERING MECHANICS**

**DATE : 30 APRIL 2012 ( MONDAY )**  
**DURATION : 2 HOURS ( 2.30 PM - 4.30 PM )**

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This paper consists of **FIFTEEN (15)** pages including the front page.  
Section A: Objective (25 questions – answer all )  
Section B: Structured (4 questions – answer 3 questions)

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**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.)

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JJ205: ENGINEERING MECHANICS

**SECTION A**

**OBJECTIVES (25 marks)**

Instructions: This section consists of 25 multiple choice questions. Answer all the questions in the answer booklet.

1. Convert  $(0.005\text{mm})^2$  to  $\text{m}^2$ . [CLO 1]
  - A.  $2.5 \times 10^{-9} \text{m}^2$
  - B.  $2.5 \times 10^{-11} \text{m}^2$
  - C.  $5 \times 10^{-6} \text{m}^2$
  - D.  $5 \times 10^{-9} \text{m}^2$
2. Which of the followings are the basic measurement quantities? [CLO 1]
  - A. Statics and dynamics
  - B. mass, length and time
  - C. Area and pressure
  - D. Velocity and acceleration
3. Which are the following is a scalar quantity? [CLO1]
  - A. Force, position, mass and velocity.
  - B. Length, mass, time and velocity.
  - C. Force, velocity, acceleration and volume.
  - D. Mass, time, length and volume.
4. Find the result of adding two coplanar forces 4N at  $90^\circ$  and 2N at  $0^\circ$ . [CLO 1]
  - A.  $R = 5.47$
  - B.  $R = 4.47$
  - C.  $R = 6.47$
  - D.  $R = 7.47$

5. Identify the most suitable theorem to determine angle,  $\theta$  in figure A(5).[CLO1]

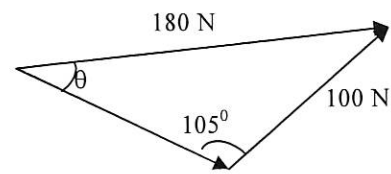
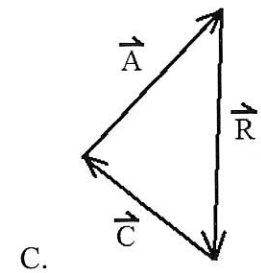
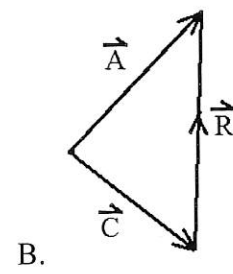
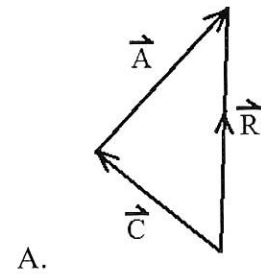


Figure A(5)

- A. Cosine Law
- B. Sine Law
- C. Newton Law
- D. Hooke Law

6. Choose the right vector addition which equivalent to resultant equation  $\vec{C} + \vec{A} = \vec{R}$ . [CLO 1]



D. None of them.

7. Calculate the dot product of P.Q. Given;  $P = (5i - 8j + 3k)$  and  $Q = (4i - 7j - 9k)$  [CLO 1]

- A. -9
- B. 49
- C. -63
- D. -12

8. Choose a true fact about equilibrium of particle. [CLO 1]

- A.  $\sum F = 0$
- B. Particle is in equilibrium it is at rest originally condition.
- C. Using Newton's Law of motion to maintain equilibrium.
- D. All true.

9. The particle is said to be in equilibrium when, [CLO1]

- A. Particle has a magnitude of the acceleration
- B. Acted upon by an unbalance force
- C. The resultant of all forces acting on particle is zero
- D. A particle move to the left after responding to each other

10. Choose the correct statement for the assumption of truss analysis below [CLO1]

- i. Truss members are connected only at their ends.
- ii. Truss members are connected by frictionless pins.
- iii. Trusses are loaded only at the joints.

- A. i & ii
- B. i & iii
- C. ii & iii
- D. i, ii & iii

11. By referring to Figure A (11), which of the following equation represent the equilibrium of forces in the x-axis. [CLO 1]

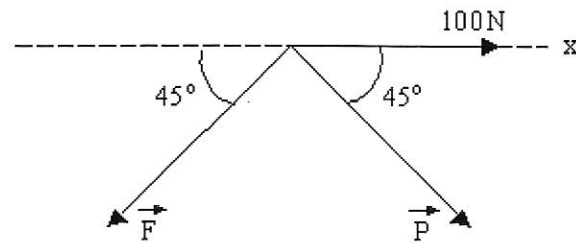


Figure A(11)

- A.  $F\cos 45^\circ + P\cos 45^\circ = 0$
- B.  $P\sin 45^\circ - F\cos 45^\circ = 0$
- C.  $P\cos 45^\circ - F\cos 45^\circ + 100 = 0$
- D.  $P\cos 45^\circ - F\cos 45^\circ = 100$

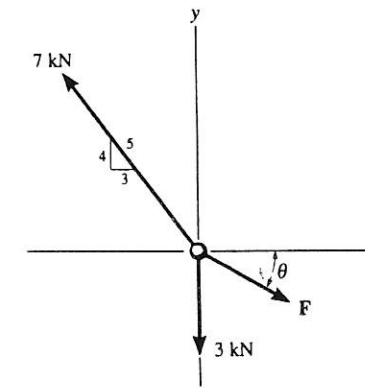


Figure A (12)

12. Determine the correct component of  $F_x$  and  $F_y$  so that the particle is in equilibrium. (Refer figure A (12)). [CLO1]

- A.  $\sum F_x = 0; -7(\frac{4}{5}) - F \sin \theta = 0, \sum F_y = 0; 7(\frac{3}{5}) + 3 + F \cos \theta = 0$
- B.  $\sum F_x = 0; -7(\frac{4}{5}) + F \sin \theta = 0, \sum F_y = 0; 7(\frac{3}{5}) - 3 - F \cos \theta = 0$
- C.  $\sum F_x = 0; -7(\frac{3}{5}) - F \cos \theta = 0, \sum F_y = 0; 7(\frac{4}{5}) + 3 + F \sin \theta = 0$
- D.  $\sum F_x = 0; -7(\frac{3}{5}) + F \cos \theta = 0, \sum F_y = 0; 7(\frac{4}{5}) - 3 - F \sin \theta = 0$

13. A 5 kg block, at rest on a smooth horizontal surface, is moved by a resultant force of 2.5 N parallel to the surface. The acceleration, in  $m/s^2$  is: [CLO1]

- A. 0.5
- B. 2
- C. 7.5
- D. 12.5

14.

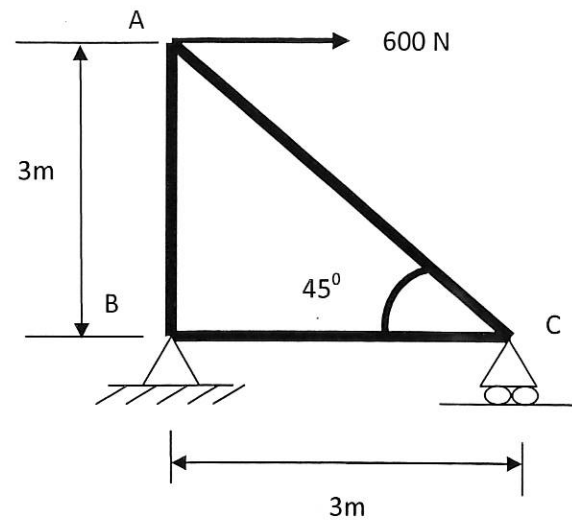


Figure A(14)

If the structure at Figure A(14) is in equilibrium, determine the force at supporting C. [CLO1]

- A. 500 N
- B. 550 N
- C. 600 N
- D. 580 N

15. One of the methods used in determining the forces developed in truss is [CLO1]

- A. Method of pinning.
- B. Method of brazing.
- C. Method of joint.
- D. Method of riveting.

16. A small metal particle passes through a fluid while being subjected to the attraction of a magnetic field. The position of the particle is given by  $s = (15t^3 - 3t)$  mm, where  $t$  is measured in seconds. Determine the particle's displacement of the particle from  $t = 2$  s to  $t = 4$  s. [CLO 1]

- A.  $\Delta s = 104$  mm
- B.  $\Delta s = 114$  mm
- C.  $\Delta s = 154$  mm
- D.  $\Delta s = 214$  mm

17. "For particle in uniform rectilinear motion, the acceleration is zero and the velocity is constant". Describe this statement. [CLO 1]

- A.  $\frac{dv}{dx} = V = \text{const} \tan t$
- B.  $\frac{dv}{dt} = Vt = \text{const} \tan t$
- C.  $\frac{dx}{dt} = V = \text{const} \tan t$
- D.  $\frac{dt}{dx} = Vt = \text{const} \tan t$

18. The unit of work done in S.I system is called [CLO 1]

- A. Newton
- B. Joule
- C. watt
- D. kg

Question 19 and 20 refer Statement 1.

**Statement 1:**

A motorist enters a freeway at 36km/h and accelerates uniformly 90km/h. From the odometer, shows that she had traveled 0.2km while accelerating.

19. Determine the acceleration rate of the car. [CLO 1]
- $-1.313 \text{ m/s}^2$
  - $1.313 \text{ m/s}^2$
  - $-17.0 \text{ km/h}^2$
  - $17.0 \text{ km/h}^2$
20. Determine the time required to reach 90km/h. [CLO 1]
- 11.43 s
  - 11.43 h
  - 3.18 ms
  - 3.18 mh
21. Ability of a body to do work by virtue of its motion is called \_\_\_\_\_. [CLO 1]
- Potential Energy
  - Human Energy
  - Maximum Tension
  - Kinetic Energy
22. What is work? [CLO 1]
- Work is defined as force acting upon an object to cause a displacement in the direction of the applied force.
  - Work is defined as kinetic energy acting upon an object to cause a displacement in the direction of the applied kinetic energy.
  - Work is defined as potential energy acting upon an object to cause a displacement in the direction of the applied potential energy.
  - Work is defined as momentum acting upon an object to cause a displacement in the direction of the applied momentum.

23. What is the potential energy of a 10 kg mass at 100 m above the surface of the earth? [CLO 1]
- 98.1kJ
  - 9.81kJ
  - 0.981kJ
  - 0.0981kJ
24. An automobile weighing 1800 kg is driven down a  $5^\circ$  incline at a speed of 100 km/h when the brakes are applied, causing a constant total braking force of 6.5 kN. Determine the time required for the automobile to come to a stop. [CLO 1]

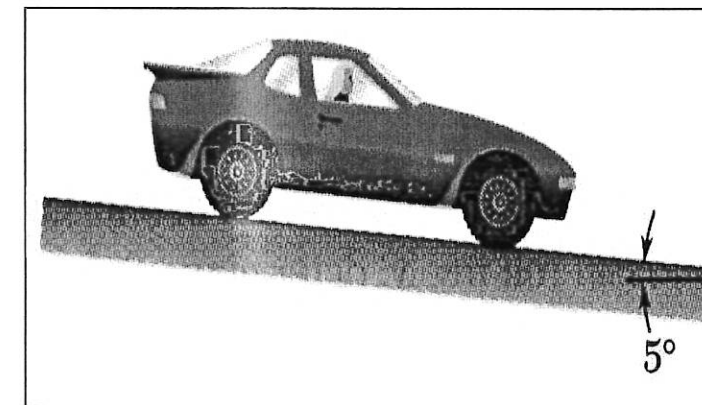


Figure A (24)

- 10.64 s
- 11.38 s
- 10.08 s
- 9.87 s

25. A 120 g baseball is pitched with a velocity of 24 m/s. After the ball is hit by the bat, it has a velocity of 36 m/s in the direction shown. If the bat and ball are in contact for 0.015 s, determine the average impulsive force exerted on the ball during the impact.[CLO1]

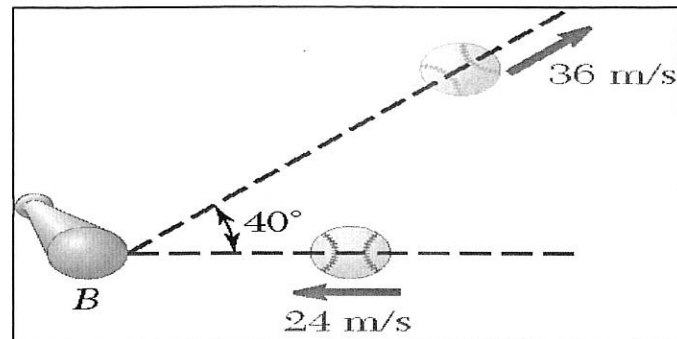


Figure A (25)

- A. 1.5 m/s to the right
- B. 2 m/s to the left
- C. 2 m/s to the right
- D. 3.3 m/s to the left

SECTION B

STRUCTURES / ESSAY (75 marks)

Instructions: This section consists of FOUR (4) structure questions. Answer THREE (3) questions.

QUESTION 1

- (a) State the three law of motion [CLO 1] (3 marks)
- (b) Define scalar and vector quantities? [CLO 1] (4 marks)
- (c) Given vector  $F = (450N) i + (600N) j - (1800N) k$ . Determine the magnitude and direction ( $\alpha, \beta, \gamma$ ) of these force.[CLO1] (8 marks)
- (d) A Force of 600 N is exerted on a bolt A as shown in Figure B (1). Determine the horizontal and vertical components of the force. [CLO 1]

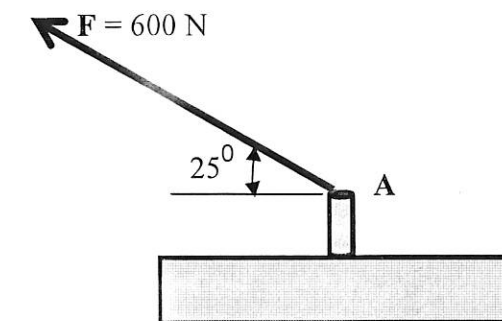


Figure B (1)

(10 marks)

QUESTION 2

- a) Based on Figure B (2a) below, the 4 kg block is suspended by AB and AC members, [CLO 1]

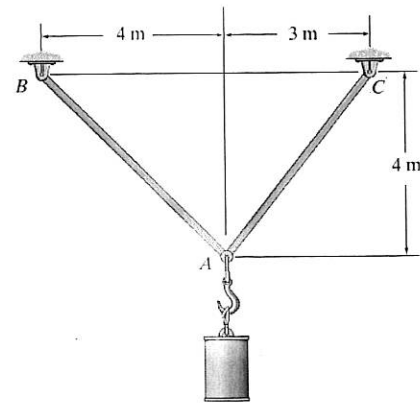


Figure B (2a)

- i. Draw Free Body diagram for the system at Point A (2 marks)
  - ii. Determine the tensile force developed in members AB and AC (11Marks)
- b) The truss used to support a balcony, is subjected to the loading shown in Figure B (2b). Assume each joint as a pin. Using the method of joints determine the force in member CB, CD, DB and DE of truss. State whether the members are in tension or compression. [CLO 1]

(12 marks)

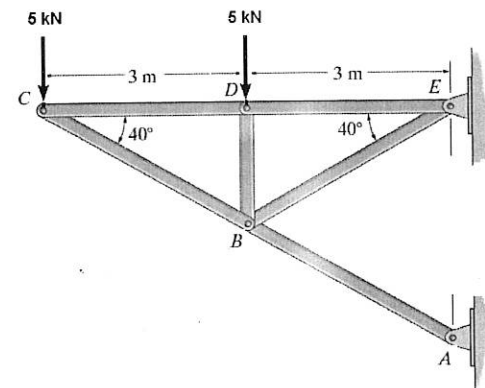


Figure 2(c)

QUESTION 3

- a) A moving particle with a mass of 3 kg with a velocity 10 m/s collided with another particle at rest with a mass of 2 kg. After the collision both particles are moving together. Determine:- [ CLO 1 ]
  - i) Their final velocities after the impact
  - ii) Kinetic energy for each particle before and after the impact.
  - iii) The energy lost during the collision.

(10 marks)

- b) A motorcycle moves with a uniform velocity of 14 m/s for 20 seconds and gradually accelerates at  $3 \text{ m/s}^2$  to a velocity of 20 m/s. After that it continues with that velocity of 20 m/s before it decelerates and finally stops in 15 seconds. The total time the motorcycle takes to stop is 45 seconds. [ CLO 1 ]

- i) Draw the graph of velocity versus time for the movement of the motorcycle (4 marks)
- ii) Calculate the deceleration of the motorcycle (3 marks)
- iii) Calculate the time taken for constant acceleration (3 marks)
- iv) Calculate the total distance traveled by the motorcycle (5 marks)

QUESTION 4

- a) Define kinetics [ CLO 1 ] (4 marks)
- b) State the Newton's second law of motion. [ CLO 1 ] (4 marks)
- c) A car of mass 950 kg accelerates up a slope with the engine pulling with a force of 1500N. If the acceleration is  $0.25 \text{ m/s}^2$ , determine the angle  $\theta$  of the slope. Assume that the friction is negligible. [ CLO 1 ] (7 marks)

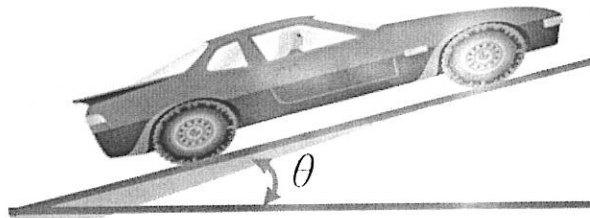


Figure B(4c)

- d) Two blocks, A and B of masses 10kg and 6 kg respectively are connected by an inextensible string over a light frictionless pulley as shown. The system is released from rest. Determine the acceleration of the mass A if the table is smooth. [ CLO 1 ]

(10 marks)

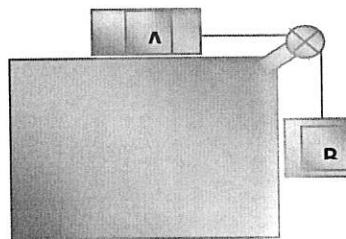


Figure B (4d)