GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

Section A

1. (a) Simplify the following:

$$\left(\frac{2}{3}+\frac{1}{4}\right)\div 4+\frac{3}{5} \qquad (4)$$

(b) In a full class of students there should be 24 students. If three students are missing determine what percentage of students remain. (4)

2. (a) Solve the following equation for x:

$$4(2x+7)=10-x \qquad (4)$$

(b) Three consecutive ODD numbers add up to a total of 87. Determine the Three numbers and show the algebraic method used to find them. (4)

3. The equation for a straight line graph is given by the following expression:

$$y = mx + c$$

Where m is the slope of the graph and c is the intercept with the y axis:

(a) plot the points shown in Table Q3 using an appropriate scale and draw the best fit line; (2)

(b) determine the values of *m* and *c* from your graph; (3)

(c) state the law of the plotted straight line. (3)

x	-2.00	0.00	2.00	4.00	6.00	8.00
y	-1.67	-1.00	-0.33	0.33	1.00	1.67

Table Q3

4. For the diagram shown in FIG Q4

Determine EACH of the following:

(a) the length of side x; (3)

(b) the length of side y. (5)

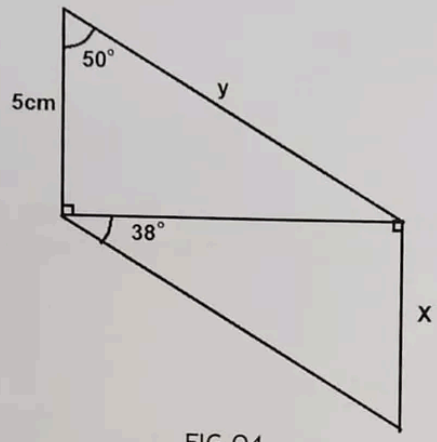

FIG Q4

5. FIG Q5 shows a quarter of a circle inscribed with two semi circles.

Determine the area of the shaded remainder. (10)

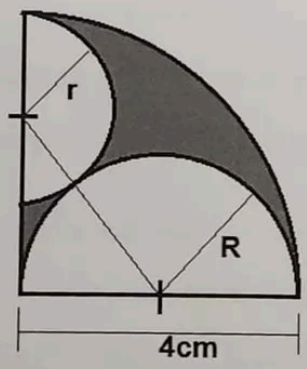

FIG Q5

6. The flow, Q, through a valve is given by:

$$Q = C\sqrt{\frac{P}{\rho}}$$

Where; C = British Standard flow coefficient, P = pressure drop across valve and ρ is the fluid density.

(a) rearrange the equation to make C the subject; (4)

(b) determine the value for C when P = 500,000 N/m^2 , ρ = 1025 kg/m^3 and the flow rate is 0.005 m^3/sec. (4)

Note: [n.b. units may be ignored]

Section B

7. Ignoring any effects of friction, the velocity of a 50 kg mass is uniformly increased from 1.5 m/s to 2.0 m/s in 5 seconds.

(a) Calculate the accelerating force required. (2)

(b) The mass is now uniformly retarded at 0.3 m/s^2 from 2.0 m/s until the mass just comes to rest.

Determine, for the retardation period, EACH of the following:

(i) the time taken to come to rest, (3)

(ii) the distance travelled. (3)

8. FIG Q8 shows a loaded uniform beam with a mass 800 kg

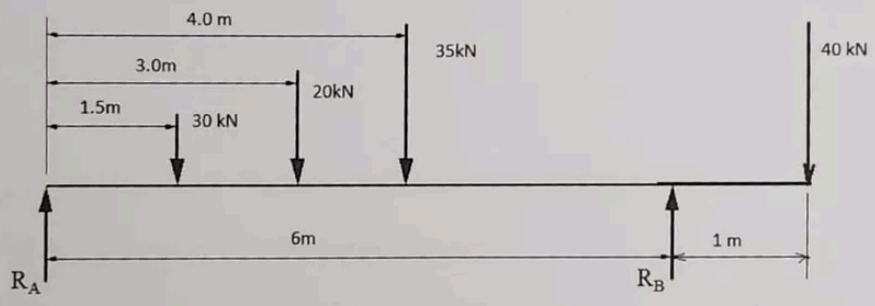

FIG Q8 (not to scale)

Determine EACH of the following:

(a) the reaction force, R_A; (5)

(b) the reaction force, R_B. (3)

9. A single drive wheel of a vehicle carries a load of 500 kg and has a tyre diameter of 600 mm. The contact surface with the road has a coefficient of friction of 0.55.

Determine EACH of the following:

(a) the limiting force that may be applied to the wheel without slippage; (4)

(b) maximum torque the transmission system may apply to the wheel without slippage. (4)

10. A lifeboat has a mass of 600 kg and is pulled alongside a distance of 90 m using a winch using a force of 150 N. It takes 1 minute and 20 seconds to complete this. Effects of friction can be ignored.

Determine EACH of the following:

(a) the acceleration of the lifeboat; (2)

(b) the average speed; (2)

(c) the work done; (2)

(d) the power required. (2)

11. A hoist has a pulley and axle with the following dimensions:

Pulley diameter = 200 mm Axle diameter = 50 mm

(a) Produce a simple dimensioned sketch of the lifting machine. (2)

(b) Determine EACH of the following:

(i) the movement ratio of the machine; (3)

(ii) the efficiency of the machine if it requires an effort of 310 N to just lift a mass of 75 kg. (3)

12. A hydraulic ram has a working length of 1.4 m. It is to be made of steel with a yield strength of 560 MPa and a Modulus of Elasticity of 210 GPa. To avoid buckling the design requires a factor of safety of 4.5 for a working load 210 kN.

Determine EACH of the following:

(a) the maximum working stress; (3)

(b) the minimum diameter of the rod; (4)

(c) the direct strain in the rod. (3)