

**GENERAL ENGINEERING SCIENCE I**

Attempt ALL questions.

Marks for each question are shown in brackets.

**Section A**

1. (a) Simplify the following giving your answer as a mixed number: (4)

$$6\frac{1}{4} + 2\frac{1}{2} + 5$$

- (b) Prove whether the statement is True or False "two thirds of twelve fifths is the same as twelve fifths of two thirds". (4)

2. A mooring rope is held firmly at each end and sags under its own weight. The amount by which it sags is given by the approximate expression:

$$s = \sqrt{\left(\frac{3d(L-d)}{8}\right)}$$

Determine the value for L when  $s = 0.75$  and  $d = 1.15$ . (8)

3. A function is given by the equation:

$$y = 1.5x^2 + 2$$

- (a) determine a table of data for the range  $x = -2$  to  $x = 2$  showing the method used; (4)
- (b) sketch a graph of the data determined in Q3(a); (4)
- (c) from the graph estimate the value for  $x$  when  $y = 5$ . (2)

4. FIG Q4 shows a right-angled triangle with a rectangle inscribed within it.

Determine the area of the rectangle:

(8)

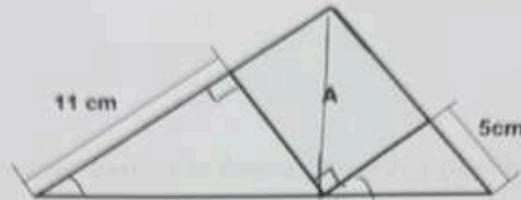


FIG Q4

5. Using Pythagoras' Theorem, determine the length AC as shown in FIG Q5:

(8)

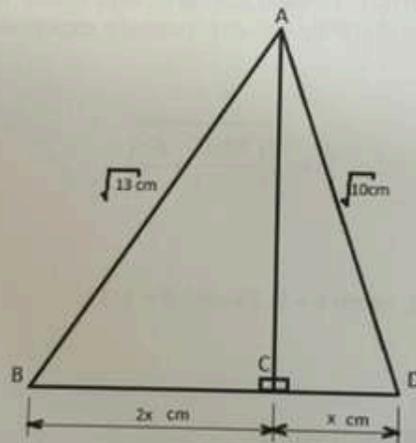


FIG Q5

6. Two solid objects are compared to each other. The first is a cone with a height of 1.1 m and a base diameter of 0.9 m. The second is a sphere with a diameter of 0.9 m.

Show which object has the greater total surface area.

(8)

**Section B**

7. A box with a mass of 30 kg has a steady force of 95 N applied to it, at an angle of  $20^\circ$  above the horizontal. There is a friction coefficient of 0.22 between the box and the surface.

Determine EACH of the following:

- (a) the acceleration of the body; (4)  
(b) the distance the body will have travelled in 10 seconds. (4)

8. A hoist has a mechanical efficiency of 72%. The motor power is measured at 8 kW when raising a mass of 1000 kg through a distance of 12 m.

Determine EACH of the following:

- (a) the work done; (4)  
(b) power output; (4)  
(c) the time taken to raise the load. (2)

9. A mass of 97 kg has its velocity uniformly increased from stationary to 4.2 m/s in 12 seconds. The mass is then decelerated at  $0.3\text{m/s}^2$  until it comes to a stop.

Determine EACH of the following:

- (a) the accelerating force required; (3)  
(b) the time taken in the deceleration phase; (3)  
(c) the total distance travelled. (2)

*Note: any effects of friction may be ignored.*

10. A replenishment at sea operation is taking place as shown in FIG Q10 where the two cables form an effective right angle at M and can be considered straight. The mass of the cable does not need to be accounted for. Point A and Point B are at the same height.

Determine EACH of the following:

- (a) the tensile force in cable AM; (4)  
 (b) the tensile force in cable BM. (4)

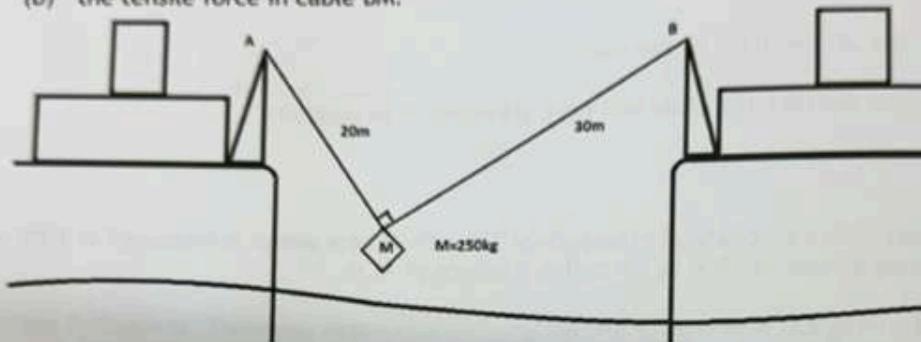


FIG Q10

11. A piston rod 0.9 m long has a diameter of 95 mm with a material stress limit of 580 MPa and a Young's Modulus of 200 GPa. The piston diameter is 400 mm and may be subjected to peak pressures of 150 bar.

Determine EACH of the following:

- (a) the direct stress in the rod; (3)  
 (b) the direct strain in the rod; (3)  
 (c) the factor of safety in the rod. (2)

12. (a) State 2 fundamental units. (2)  
 (b) What are derived units, give an example. (2)  
 (c) A cylinder with an internal cross-sectional area of  $4250 \text{ mm}^2$  contains fluid with a depth of 6 cm. The fluid has a mass of 300 grams.  
 Determine the density of the fluid and illustrate how the units were formed. (4)

