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LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

EXAMINATION PERIOD
JANUARY 2016

CYFNOD ARHOLIADAU
IONAWR 2016

MODULE CODE: M3X01513
SCIENCE

TIME: 1 ½ HOURS

ANSWER ALL QUESTIONS

Equipment or materials required –

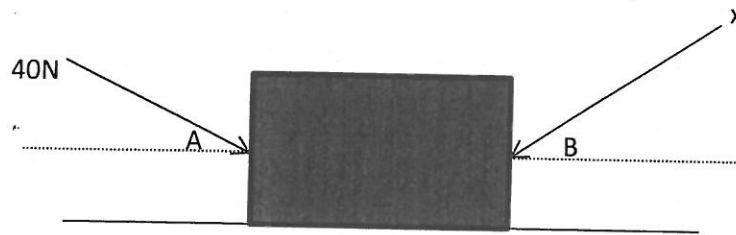
Calculators allowed

Formulae provided on final page of this exam script

Work to 2 decimal places

Assume $g = 9.81\text{ms}^{-2}$

QUESTION ONE



Where angle A is 25 degrees and angle B is 33 degrees.

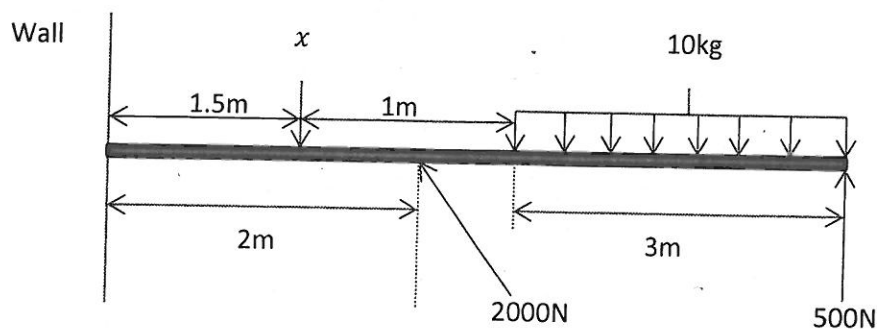
If the above block of mass 30kg is resting on a smooth horizontal surface, calculate the following:

- ~~(i) Calculate the reaction force between the block and the surface.~~
- (ii) The force x required to keep the system in equilibrium.
 - (iii) If the 40N is removed, calculate the acceleration of the block along the surface.

(4)

QUESTION TWO

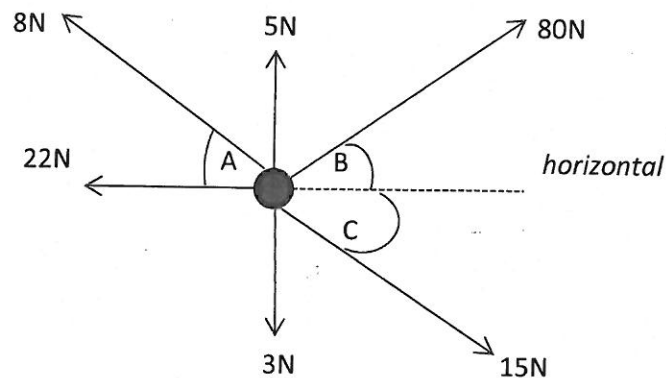
If the 2000N force is acting at 30 degrees to the horizontal, find the mass x that needs to be placed to keep the following system in equilibrium:



(4)

QUESTION THREE

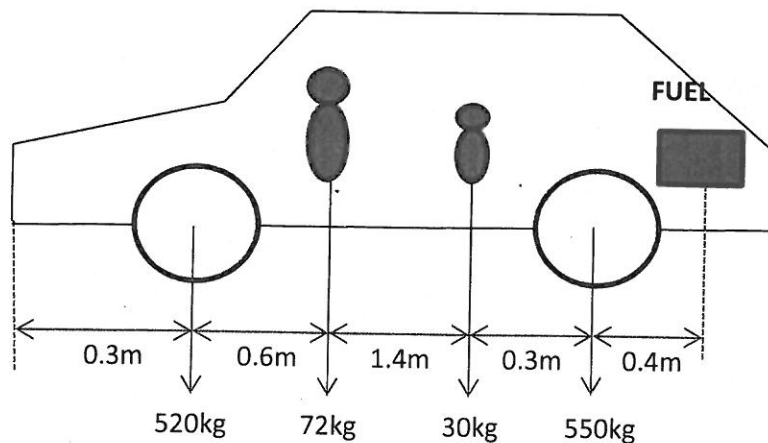
If angle A = 20 degrees, angle B = 35 degrees and angle C = 28 degrees, calculate the resultant force and direction to the horizontal for the following particle:



If the mass of the particle is 8kg, calculate the acceleration (neglect gravitational force).

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QUESTION FOUR



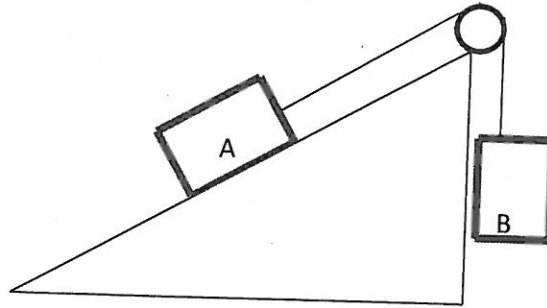
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Calculate the centre of gravity of the above car relative to the front nose. The fuel used is petroleum, which has density of 0.82kg/l. 35 litres of fuel is currently in the car.

QUESTION FIVE

Two blocks are connected via a light, inextensible rope that rests on a frictionless pulley. Block A is resting on an inclined plane, which is inclined at 35 degrees to the horizontal. The coefficient of friction between block A and the plane is 0.12.

If block A has a mass of 10kg and block B has a mass of 45kg, calculate the tension in the rope and the acceleration of the blocks.

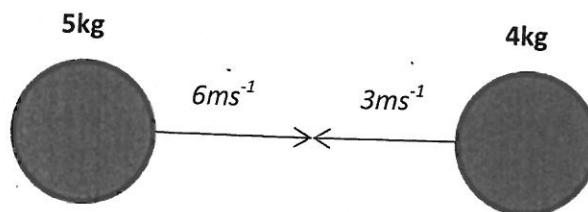


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QUESTION SIX

A 5 kg mass moving at 6 ms^{-1} makes a head-on collision with a 4 kg mass travelling at 3 ms^{-1} . Assuming that there are no external forces acting on the system, what are the velocities of the two masses after impact?

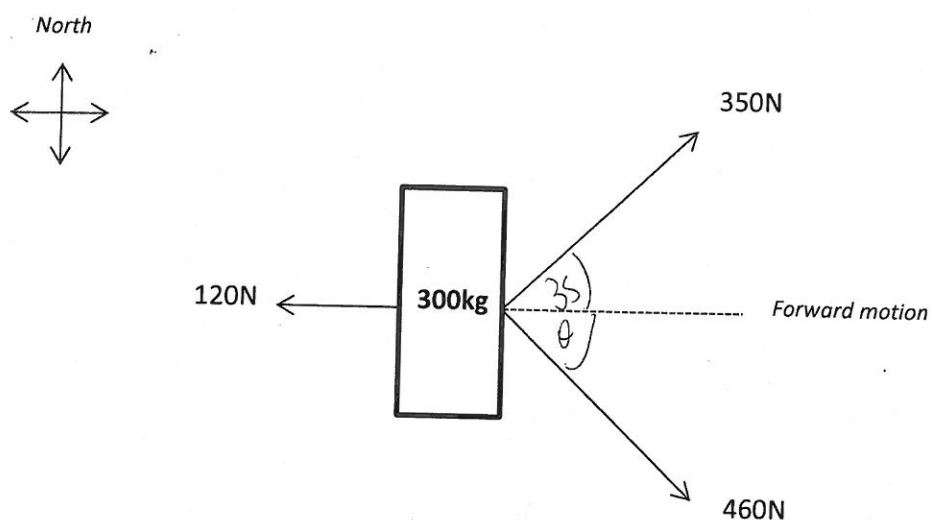
(Assume coefficient of restitution $e = 0.5$)



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QUESTION SEVEN

A container is being pulled along by two people, one 35 degrees North of forward motion, the other θ degrees South of forward motion. There is a resistance to motion of 120N. Calculate θ and the acceleration of the container.



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Formula sheet

$$g = 9.81\text{ms}^{-2}$$

Trigonometry

$$S = \frac{O}{H} \quad C = \frac{A}{H} \quad T = \frac{O}{A}$$

Density

$$\rho = \frac{\text{mass}}{\text{volume}}$$

Momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$e = \frac{\text{velocity of separation}}{\text{velocity of approach}}$$

Foundation Science Exam Jan 2016

Question No.

Examiner Only

Q1)

(i)

~~2 x 30g~~

$\leftarrow = \rightarrow$

$$40 \cos 25 = x \cos 33$$

$$36.25 = 0.84 x$$

$$43.15 \text{ N} = x$$

(ii)

$$F = ma$$

$$43.15 \cos 33 = 30 a$$

$$36.18 = 30 a$$

$$1.21 \text{ m s}^{-2} = a$$

(4)

Q2)

$$C_{wm} = CC_{wm}$$

$$(xg \times 1.5) + (10g \times 4) = (2000 \cos 60) + (500 \times 5.5)$$

$$14.72x + 392.4 = 1000 + 2750$$

$$14.72x = 3750 - 392.4$$

$$14.72x = 3357.6$$

$$x = 228.10 \text{ Kg}$$

(4)

Q3)

$$\uparrow = \downarrow$$

$$8 \cos 70 + S + 80 \cos 55 = 3 + 15 \cos 62$$

$$2.74 + S + 45.89 = 3 + 7.04$$

$$S3.63 = 10.04$$

$$\uparrow 43.59 \text{ N} =$$

$$\leftarrow = \rightarrow$$

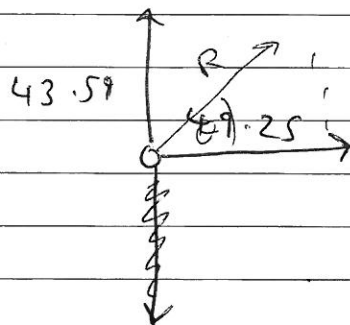
$$22 + 8 \cos 20 = 80 \cos 35 + 15 \cos 28$$

$$22 + 7.52 = 65.53 + 13.24$$

$$29.52 = 78.77$$

$$\therefore = 49.25 \text{ N}$$

$$\rightarrow$$



$$R^2 = 43.59^2 + 49.25^2$$

$$R^2 = 1900.09 + 2425.56$$

$$R = \sqrt{4325.65}$$

$$R = 65.77 \text{ N}$$

Q3

$$\tan \theta = \frac{43.59}{49.25}$$

$$\theta = \tan^{-1}(0.89)$$

$$\theta = 41.67^\circ \text{ above horizontal}$$

$$F = ma$$

$$65.77 = 8a$$

$$8.22 \text{ ms}^{-2} = a$$

Q4) $\rho = \frac{m}{V}$

$$\rho V = m$$

$$0.82(35) = m$$

$$28.7 \text{ kg} = m_{\text{fuel}}$$

$$\text{Sum masses} = 520 + 72 + 30 + 550 + 28.7$$

$$= 1200.7$$

$$\text{Sum Weight} = 1200.7 \text{ g}$$

moments about nose:

$$C_{wm} = C_{cm}m$$

$$(520 \text{ g} \times 0.3) + (72 \text{ g} \times 0.9) + (30 \text{ g} \times 2.3) + (550 \text{ g} \times 2.6) + (28.7 \text{ g} \times 3)$$

$$1530.36 + 635.69 + 676.89 + 14028.3 + 844.64 = (1200.7 \text{ g} \times x)$$

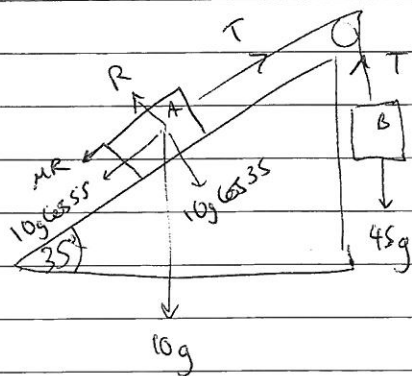
$$17715.88 = 11778.87x$$

$$1.50 \text{ m from nose} = x$$

Q

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Q5)



$$\mu = 0.12$$

$$R = 10g \cos 35^\circ$$

$$\therefore \mu R = 0.12(10g \cos 35^\circ)$$

$$\mu R = 9.64 \text{ N}$$

$$\textcircled{A} \quad F = ma$$

$$T - 10g \cos 35^\circ - 9.64 = 10a$$

$$T - 65.91 = 10a \quad \textcircled{1}$$

$$\textcircled{B} \quad 45g - T = 45a \quad \textcircled{2}$$

$$45g - 65.91 = 55a$$

$$375.54 = 55a$$

$$6.83 \text{ ms}^{-2} = a \rightarrow \text{in } \textcircled{1}$$

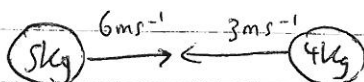
$$T - 65.91 = 10(6.83)$$

$$T = 68.3 + 65.91$$

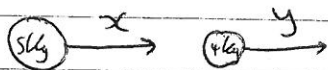
$$T = 134.21 \text{ N}$$

Q6)

Before



After



Conservation of momentum:

$$5(6) + 4(-3) = 5x + 4y$$

$$18 = 5x + 4y \quad (1)$$

CoF. restitution:

$$0.5 = \frac{y - x}{6 + 3}$$

$$0.5 = \frac{y - x}{9}$$

$$4.5 = y - x \quad (2)$$

$$18 = 5x + 4y \quad (1)$$

$$4.5 = -x + y \quad (2) \times 5$$

$$22.5 = -5x + 5y \quad (3)$$

① + ③

$$40.5 = 9y$$

$$4.5\text{ms}^{-1} = y \rightarrow \text{in } (2)$$

$$x = y - 4.5$$

$$x = 4.5 - 4.5$$

$$x = 0\text{ms}^{-1}$$

Q7)

$$\uparrow = \downarrow$$

$$350 \cos 35 = 460 \cos (90 - \theta)$$

$$200.75 = 460 \cos (90 - \theta)$$

$$0.44 = \cos (90 - \theta)$$

$$\cos^{-1}(0.44) = 90 - \theta$$

$$63.90 = 90 - \theta$$

$$\theta = 26.1^\circ$$

$$F = ma$$

$$350 \cos 35 + 460 \cos 26.1 - 120 = 300a$$

$$286.70 + 413.09 - 120 = 300a$$

$$579.79 = 300a$$

$$1.93 \text{ ms}^{-2} = a$$