Some vector answers (force vectors)

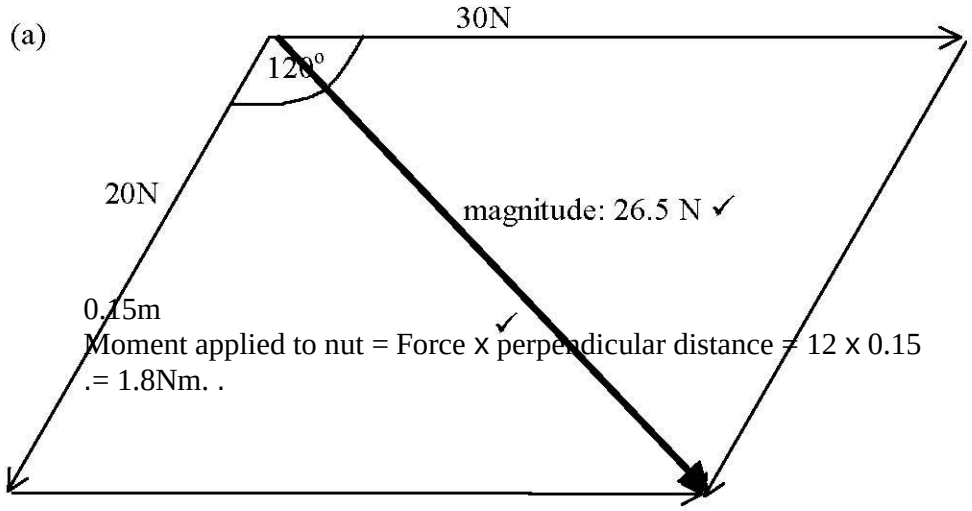
1. (a) (i) A vector has a direction, a scalar does not. .

[1]

(ii) Any two examples such as force, displacement, velocity, momentum etc…

[2]

2. (a)



0.15m

Moment applied to nut = Force x perpendicular distance = 12 x 0.15 ✓

.= 1.8Nm. .

[2]

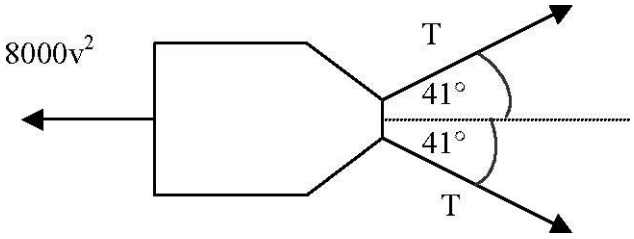
Total 6 marks

[1]

[2]

(b) $a = F / m = 26.5 / 4 = 6.6\ ms^{-2}$ [2]

3(a)



The ship travels at a steady speed so the forward force due to the cables must have the same magnitude as the drag force. Ropes are symmetrical so the magnitude of the tensions in them are equal.

Resolve forces in direction of travel: $8000v^2 = 2T \cos 41^\circ$; . $8000 \times 2.5^2 = 2T \cos 41^\circ$

$T = 33125N = 33\ kN$ [3]

(b)

Maximum speed is attained when the angle between the rope to each tug with the direction of travel is the at a minimum. Otherwise some of the force of the tugs goes to oppose the force from the other tug; . In this case the angle is 30°. The tension in the ropes is 50kN.

Resolving in the direction of motion: $2 \times 50{,}000 \times \cos 30^\circ = 8000v^2$; . Maximum speed, $v = 3.3\ ms^{-1}$. [4]