Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

The photograph shows a type of drink known as stout.

When the drink is poured, it contains many spherical bubbles of gas which rise and form the foamy 'head' at the top of the drink. The manufacturers of the drink state "It takes 120 seconds for the head to form".

For the smallest bubbles, the uniform upward velocity can be calculated using the equation

$$v = \frac{2(\rho_{stout} - \rho_{gas})r^2 g}{9\eta}$$

(i) Derive this equation by considering the forces acting on a bubble.

(3)

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(ii) State an assumption you have made.

(1)

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(iii) Evaluate the statement from the manufacturers that it takes 120 seconds for the head to form.
You should consider the time for a bubble to travel from the bottom of the glass to the top.
height of glass = 11.5 cm
density of gas = 1.22 kg m^{-3}
density of stout = 1.01×10^{3} kg m^{-3}
viscosity of stout = 2.06×10^{-3} Pa s
diameter of bubble = 122 μm

(4)

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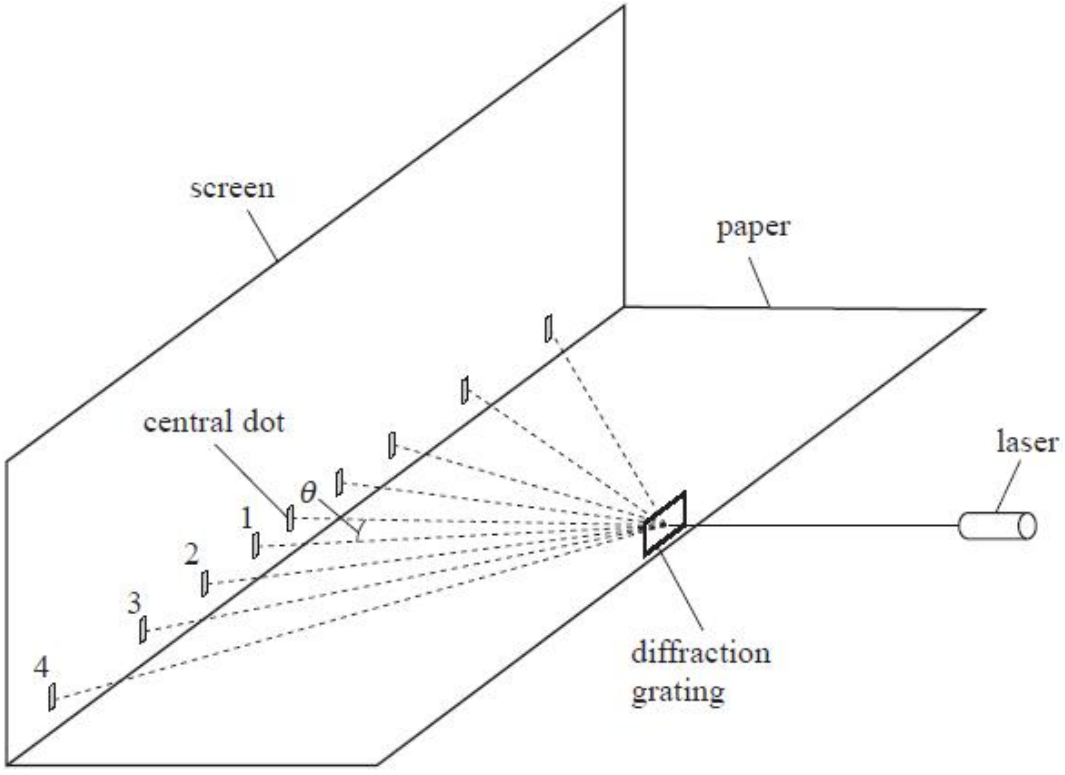
Q2.

The arrangement shown was used to determine the wavelength of light emitted by a laser.



A laser light beam was shone at a diffraction grating. A series of dots of light was produced on a screen. The angles *θ* between the light ray to the central dot and the light rays to the dots labelled 1 to 4 were measured with a protractor.

n	θ / °	$\sin\theta$
1	12	0.21
2	23	0.39
3	34	0.56
4	51	0.78

(a) Describe how the angle θ could be determined without using a protractor.

(2)

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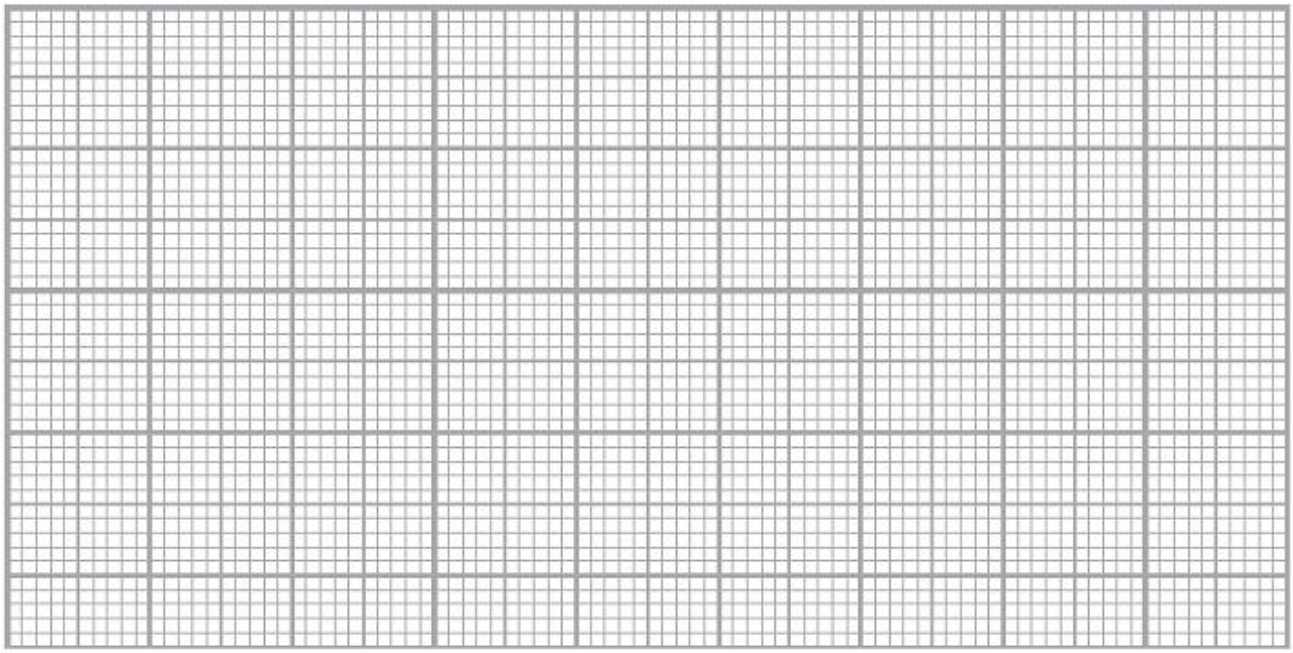
(b) Plot a graph of n against $\sin\theta$ on the grid below.

(4)



(c) The diffraction grating has 300 lines mm^{-1}.

Determine the wavelength of the laser light.

(4)

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Wavelength = ...

(Total for question = 10 marks)