

### Question 11

You have met a variety of fluid models in MST322; for example, for flows along tubes and channels, roller-coating processes, sound waves in a gas, planetary atmospheres and flows around cylindrical and spherical objects. Also you have used a variety of equations, expressed in different coordinate systems, that may be related to the Navier-Stokes equation; for example, the equation of fluid statics, Euler's equation, the wave equation, Bernoulli's equation and the equation of creeping motion.

Use this knowledge to discuss the validity of the following statement:

The Navier-Stokes equation is fundamental to the study of Newtonian fluid mechanics and has given rise to plausible explanations of various physically observed fluid phenomena.

Your answer should include at least *four* examples of fluid models. For each example:

- (i) illustrate how the modelling equation is a special case of, or is related to, the Navier-Stokes equation;
- (ii) give both a verbal and a mathematical description;
- (iii) indicate at least one physical situation for which the model is appropriate. [20]

[END OF QUESTION PAPER]