Name of the Student:_____

Max. Marks : 27 Marks **Time : 27 Minutes**

Mark Schemes

Q1.

Question Number	Answer		Mark
(a)(i)	Use of force = area x force per unit area Correct use of trigonometric function for component of force Force = 1420 (N) Example of calculation Force = 84 N m^{-2} x 18 m^2 = 1512 (N) component of force = 1512 N x cos 20° = 1420 N	(1) (1) (1)	3
(a)(ii)	Wind/air causes boat to push against water Due to Newton's third law the water exerts an opposite force **Or** force in westerly direction on the boat due to Newton's third law **Or** In east-west direction: no acceleration **Or** no resultant force Water exerts a force on the boat to balance out (component) of wind's force from the east (A bold statement of N3 without an application to the context scores 0)	(1) (1) (1) (1)	2

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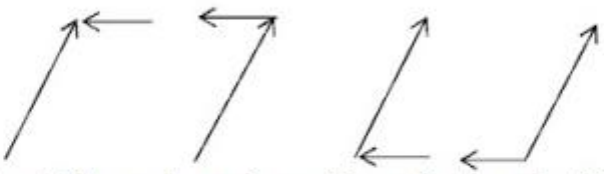
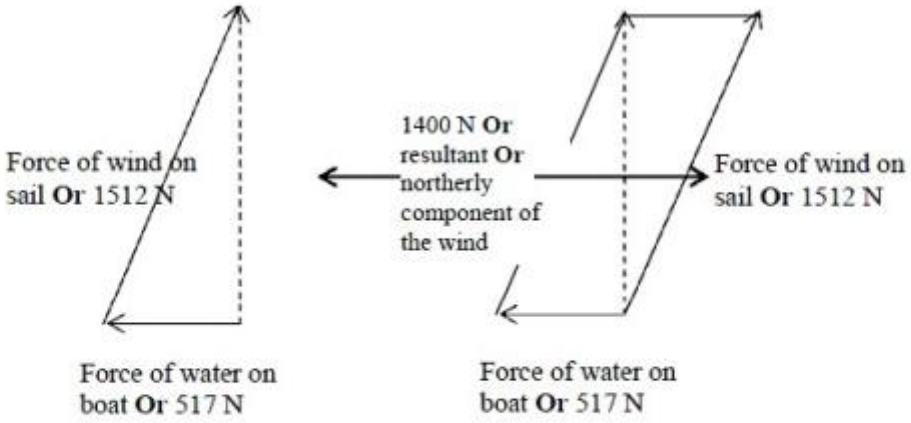
(a)(iii)	The wind and water forces labelled and in the correct directions (2 adjoining labelled lines with arrows) e.g.  (Label for the horizontal line as shown above = Force of water on boat **Or** 517 N Label for the angled line as shown above = Force of wind on sail **Or** 1512 N)	**(1)**	
	Triangle or parallelogram completed to show resultant force with direction  (Due to taking some words as being included in the stem the minimum labelling would be: Wind in place of: Force of wind on sail **Or** 1512 N Water in place of: Force of water on boat Or 517 N)	**(1)**	**2**

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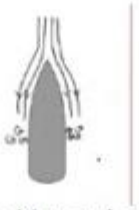
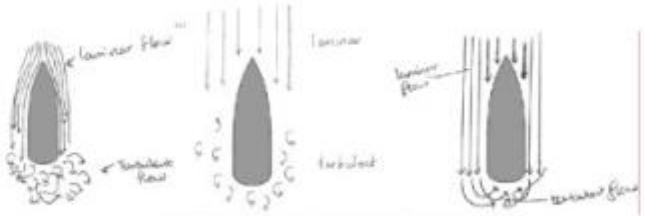
(a)(iv)	Use of $F = ma$ Acceleration = 3.6 m s^{-2} (allow ecf from (a)(i) if answer rounds to 1400 N) Example of calculation a = 1420 N / 400 kg = 3.6 m s^{-2}	**(1)** **(1)**	**2**
(b) (i)	Idea that the relative speed of wind to sail is lower e.g. As the boat is moving at 5 m s^{-1}, the (relative) speed of the wind on the sail is only 5 m s^{-1}	**(1)**	**1**
(b)(ii)	Use of $s = d/t$ or use of work done = force × displacement Rate of energy transfer = 1900 W or J s^{-1} Example of calculation Distance = speed x time = 5 m s^{-1} x 1 s = 5 (m) Power = 380 N x 5 m / 1 s = 1900 W (accept P = 380 N x 5 m s^{-1} = 1900 W)	**(1)** **(1)**	**2**
(b)(iii)	Diagram shows labelled laminar flow Diagram shows labelled turbulent flow with a continuous transition from laminar (2) (1, no labels) (1, no labels)  (0. no transition and no labels)  (all score 1, no transition) (Unlabelled diagram with the correct flow lines 1 mark max. Laminar and turbulent wrong way round but fully labelled scores 1 max)	**(1)** **(1)**	**2**

Q2.

Question Number	Acceptable Answer		Additional Guidance	Mark
	• Attempt to calculate gradient • k = (24.0 →25.0) N m^{-1}	**(1)** **(1)**	Accept k = (0.24→ 0.25) N cm^{-1} Example of calculation: gradient= $\frac{(1.6\text{-}0)\text{ N}}{(6.5\text{-}0)\times10^{-2}\text{m}}$ =24.6 N m^{-1}	**2**

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Q3.

Question Number		Mark
(a)	(The line) AB (extended)does not pass through the origin /initially **Or** the graph is curved as it passes through the origin **Or** the graph (before A) is not a straight line through the origin. (1) The device does not obey Hooke's law (conditional mark) (1)	**2**
(b) (i)	Reference to finding area (1) **Detail** count squares **OR** approximate the shape of the graph to a triangle **Or** reference to using a trapezium(could be described as rectangles and triangles) (1)	**2**
(b) (ii)	Identifies that force is the problem. (1) Explains why force used is an overestimate e.g. maximum force has been used (each time) **Or** average force was not used (each time) **Or** the force is changing (continuously) **Or** should have used the trapezium rule **Or** area of rectangle has been used (1)	**2**
(c)	Use of 25% of 540 kJ i.e. find the energy to be used (1) Use of $\frac{\text{total available energy (either 540 000 J or 135 000 J)}}{\text{energy per stretch or energy per unit time}}$ (1) Time = 612 min (1) Example of calculation 540 000 J x 25% = 135 000 J 135 000 J / 14.7 J = 9184 stretches 9184 / 15 stretches per minute = 612 minutes (36 720 s **Or** 10.2 h)	**3**
(d)	smaller extension **Or** will not stretch as much (1) less work with reference to either same force applied **Or** to work done being force x extension (1) (Do not accept displacement or distance in place of extension for MP1or MP2)	**2**
	Total for question	**11**

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