

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Mark Schemes

Q1.

- (a) Use of $p = mv$ or estimates walking speed = 1 or 2 m/s ✓

Allow use of where m has been made the subject and p has been substituted.

Accept any answer in range 2×10^6 to 10×10^6 (kg) ✓

Range on answer:

(Using speeds in range 0.5 ms^{-1} to 2.5 ms^{-1})

Accept 1 significant figure answer

2

- (b) **Max 4**

There is a force on the water (from the propeller) and this produces an equal force on the propeller (from the water in the opposite direction) ✓

Correctly links to Newton's 3rd law ✓

This force on the ship equals the drag force on the ship ✓ Correctly links to Newton's 1st law ✓

Force is needed to change the water's momentum ✓ Correctly links to Newton's 2nd law ✓

Must link correct law to at least one correct statement for all 4 marks

4

- (c) (When system is enabled,) drag decreases by more than thrust

Or

(When system is enabled,) decrease in work done (per second) against drag (at any speed) is greater than the decrease in the work done by the propeller (at any rotational speed) ✓

Work done (per second) by drag decreases and work done (per second) by propeller decreases (at any rotational speed) ✓

To maintain constant momentum then drag must equal thrust ✓

Propeller can operate at lower rotational speed so that thrust again equals drag

Or

Engine does less work (and less fuel needs burnt) ✓

3rd MP: Accept answer in terms of power = Fv

Q2.

- (a) Spreading of pulse / parts of a pulse take different times to travel through the fibre / pulse broadening ✓

Do not credit material dispersion.

owtte

Due to different paths through the optical fibre / due to entering the optical fibre at different angles ✓

Accept a diagram showing different paths.

2

(b) $\text{speed} (= \frac{\text{distance}}{\text{time}}) = \frac{10 \times 10^3}{5.225 \times 10^{-5}} \quad \checkmark \quad (= 1.91 \times 10^8)$

1

- (c) Reads off $\sin \theta_R = 0.3391$

or

use of $n_1 \sin \theta_1 = n_2 \sin \theta_2$ ✓

Use of $n = \frac{c}{c_s}$ seen ✓

With their $\sin \theta_R$

(Refractive index of core = 1.47)

Allow use of their refractive index where c_s is the subject of the formula

$$c_s = 2.03 \times 10^8 \quad \checkmark$$

Alternative:

Reads off $\sin \theta_R = 0.3391$

or

$$\theta = 19.8^\circ \quad \checkmark$$

$$c_s \cos 19.8 = 1.9 \times 10^8 \quad \checkmark$$

$$c_s = 2.03 \times 10^8 \quad \checkmark$$

Allow finding θ_R for their read off

Allow use of their θ_R

3

- (d) The refractive index of core for blue light is greater than the refractive index for red / The refractive index of core for red light is less than the refractive index for blue ✓

Max 1 mark for stating that the refractive indices are different because their speeds are different

MP1 can come from graph or prior knowledge

The speed of the blue light is less than the speed of the red light and travel the

same distance / The speed of the red light is greater than the speed of the blue light and travel the same distance ✓

2

(e) the blue now travels a shorter distance than the red light (compared to (d)) ✓

or

the red light now travels a greater distance than the blue light (compared to (d)) ✓

or

the difference between the blue's velocity parallel to the central axis and the red's velocity (parallel to the central axis) has decreased (compared to (d)). ✓

Allow: now travel different distances whereas previously travelled the same distance.

or

the difference between the horizontal velocity of the red light and the horizontal velocity of the blue light has decreased (compared to (d)). ✓

1

[9]