Markscheme for 2019 Sec 3 EOY PHYSICS

Paper 1

1 . .5	6 .10	11 ..15	16 ..20	21.. 25	26.. 30
CADAC	BDCCD	ADBBB	ADCDA	ADDBB	AACDD

3 D Accuracy is how close the values are to the true value, while precision is how close the values are to each other. A large number of students chose the option 'A', however the values are neither accurate nor precise as the average of the values is not close to the true value of g which is $10ms^{-2}$.	**6 B** Velocity is the gradient of displacement time graph. As the car goes down the slope, the velocity increases, thus the gradient of the graph should be increasing. Along the horizontal path, the velocity remains the same, thus the gradient remains constant.
8 C Acceleration is the due to the resultant force acting on the object (F=ma). Since the only force on the object is weight, the acceleration remains at g throughout the motion.	**12 D** By F=ma, a constant net force F, means a constant m and a. With a constant a, there must be a change in velocity.
14 B Draw free body diagrams for each individual box N and M. Apply F = ma for each box. For box M, $F_{N\ on\ M} = 3a$ For box N, $70 - F_{M\ on\ N} = 7a$ $70 - 3a = 7a$ $10a = 70$ $a = 7\ ms^{-2}$ Net force on box N = 7a = 7 x 7 = 49 N	**27 A** The rock possesses the most energy at the top of hill as it has GPE. At any other point, it has energy transferred to the surroundings or work done from the surroundings.

Paper 2 Section A (40 marks)

1 **(a)** **(i)** −0.03 cm

(ii) diameter
= 4.06 + 0.03
= 4.09 cm

cross-sectional area
= $\pi(d/2)^2$
= $\pi(4.09/2)^2$
= 13.1 cm^2

(b) Rotate the vernier caliper to obtain different readings of the diameter at the same point and take the average.
Measure the diameter at different points along the whole length of the rod and take the average.

2 **(a)**

$$v^2 - u^2 = 2as$$
$$v^2 = 2(10.0)(4.5) + (2.0)^2$$
$$v = 9.7 \text{ m s}^{-1} \text{ (2 sf)}$$

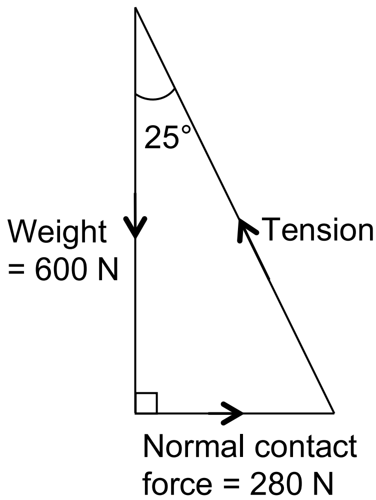
(b)

$$at = v - u$$
$$(10)\,t = 9.695 - 2.0$$
$$t = 0.77 \text{ s (2 sf)}$$

(c) The time taken would be the same.
The gravitational acceleration experienced by both balls is the same.

3 **(a)** No net or resultant force acts on the climber.
No net or resultant moment acts on the climber.

(b)



4 **(a)** The lamp rotates clockwise and topples over.
As the lamp tips, its weight gives rise to a clockwise moment about the pivot causing it to topple in the clockwise direction.

(b) Make the base of the lamp wider/ broader.
Make the base of the lamp heavier.

5 **(a)** Let the normal contact force exerted by wall be N_D.
Taking moments about E, by the Principle of Moments,

sum of anticlockwise moments = sum of clockwise moments

$$20 \times 0.35 = N_D \times (0.10 + 0.20)$$

$$N_D = 23\text{ N (2 sf)}$$

(b) Let the normal contact force exerted by wall be N_E.
N_E = weight = 20 N

(c) The magnitude of N_E would be lower as N_E is now equal to the difference between weight and friction.

6 **(a)** A point **'S'** labelled anywhere along the bottom of the manometer.

(b)

$$P_{atm} = h\rho g$$

$$0.75 \times 13\,600 \times 10 = h_{water} \times 1000 \times 10$$

$$h_{water} = 10.2\text{ m } H_2O$$

$$P_{gas} = P_{atm} + 50\text{ cm } H_2O$$

$$P_{gas} = 10.2\text{ m} + 0.50\text{ m}$$

$= 10.7$ m H_2O (1d.p.) or 107 000 Pa (whole number) or 110 000 (2sf) or 79 cm Hg (whole number)

(c)

$$P_1V_1 = P_2V_2$$

$$(10.7\text{ m } H_2O)(0.012\text{ cm}^3) = P_2\,(0.013\text{ cm}^3)$$

P_2 = 9.9 m H_2O or 99 000 Pa or 73 cm Hg (2sf)

Assumption is that mass and temperature of the gas remains constant.

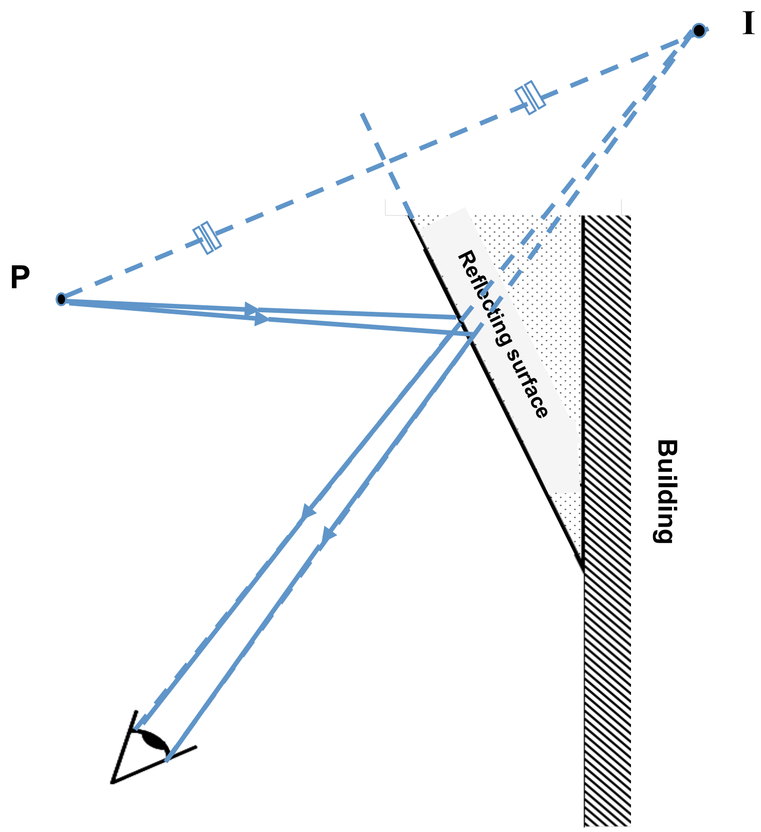
7 **(a)** The small force will exert a pressure on the hydraulic fluid through the area on the small piston. By Pascal's Principle, this **pressure is transmitted uniformly** to all parts of the hydraulic fluid, thus it **exerts the same pressure** on the large piston.
As the **area of the large piston is large**, due to **P = F/A**, the force exerted by the large piston is larger as well. This generates a large force that compresses the object.

(b) By the principle of conservation of energy, the **work done by the small force** on the small piston must be **equal to the work done by the large force** on large piston.
Since the **force on the small piston is smaller**, the **distance moved must be longer** for the work done to be the same.

OR

The liquid is incompressible, thus the **volume remains constant** . Therefore, since the **cross sectional area of the small piston is small**, the **distance moved will be larger.**

8 (a)

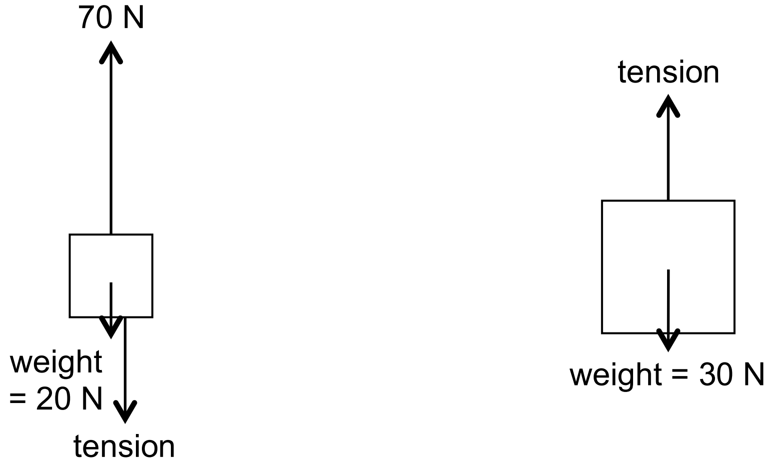


(b) The observer's prediction is **wrong**. This is because image formed in plane mirrors are the **same size/ smaller to the observer** as the object and is **upright**.

Section B (30 marks)

9 (a) Newton's Second Law of Motion states that the resultant force acting upon an object is equal to the product of the mass and the acceleration of the object; the direction of the force is the same as that of the object's acceleration.

(b)



(c)
$$F_{net} = ma$$
$$70 - 50 = (5.0)\,a$$
$$a = 4.0 \text{ m s}^{-2}$$

(d)
$$F_{net} = ma$$
$$T - 30 = (3.0)(4.0)$$
$$T = 42 \text{ N}$$

(e) Tension would become zero.
When the blocks undergo free-fall, the net force acting on each block would just be the weight of the objects. Therefore, the tension will be zero.

10 (a) (i) Using the speed of wind,
The distance the air travels per second is 8.0 m.

Volume of air travelling per second
= Cross sectional area x distance
= πr^2 x 8.0
= $\pi (40)^2$ x 8.0
= 40 200 m^3
= 40 000 m^3 (2sf)

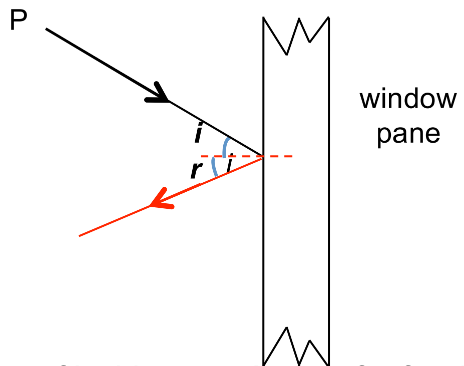
(ii) Density of air per second
= mass / volume
= 90 000 / 40200
= 2.24 kg m^{-3} s^{-1} (2 or 3 sf)

(iii) rate of kinetic energy per second
= ½ mv^2
= ½ $(90\,000)(8.0)^2$
= 2.9 x 10^6 J s^{-1} (2sf)

(iv) A large amount of air passes through the area without turning the blade OR some energy is used to do work against friction at the pivot OR the wind speed is not constant throughout the day

Reject some energy is converted to sound and thermal energy of the blades, as the sound is wind and thermal energy due to friction between air and blades is too negligible as compared to the two reasons above.

(b) (i)



Angle of incidence = Angle of reflection = 30° (±1°)

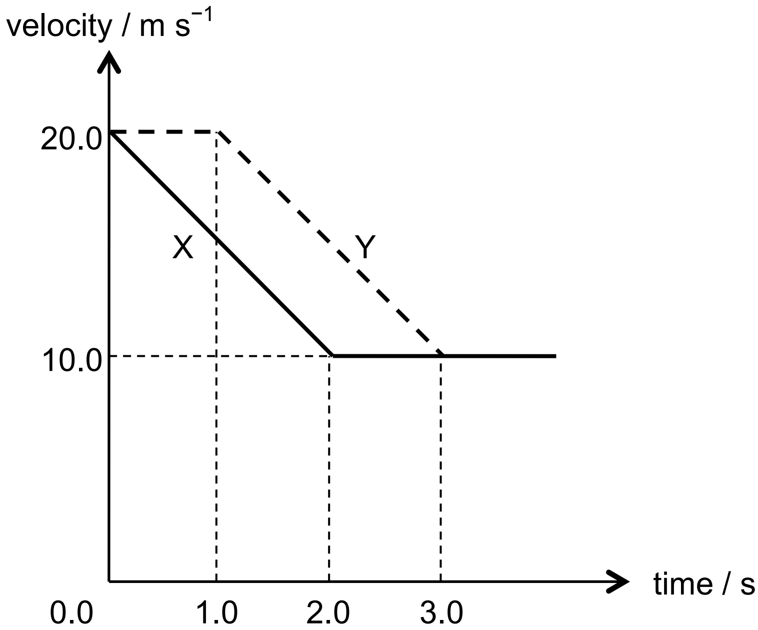
(b) (ii) The first law of reflection is that the angle of incidence is equal to the angle of reflection.
The second law of reflection is that the incident ray, the reflected ray and the normal all lie on the same plane.

(b) (iii) Angle of deviation
$= 180^o - 30^o - 30^o$
$= 120^o$

11 EITHER

(a) Rate of change of velocity

(b)



(c) $a = (v - u)/t$
$a = (10.0 - 20.0)/2.0$
$= -5.0 \text{ m s}^{-2}$

Deceleration
$= 5.0 \text{ m s}^{-2}$

(d) Distance travelled by X
$= 0.5\,(20.0 + 10.0)(2.0) + (10.0)(1.0)$
$= 40$ m

Distance travelled by Y
$= (20.0)(1.0) + 0.5\,(20.0 + 10.0)(2.0)$
$= 50$ m

Difference
$= 50 - 40$
$= 10$ m

(e) 5.0 m

11 OR

(a) Pressure at 140 m = Atmospheric pressure + hpg

Atmospheric pressure
= 140 (1000) (10)
= 1 400 000 Pa

Pressure at 140 m
= 100 000 + 140 (1000) (10)
= 1.50×10^6 Pa

(b) (i) P = F/A
F = P x A
F = $1.50 \times 10^6 \times 0.65$
= 9.8×10^5 N (2 sf)

(b) (ii)

1. To open the hatch up, the weight of the metal hatch/upthrust/water resistance has not been taken into account.
2. As the hatch rotates the perpendicular distance from the pivot decreases and hence the force applied must also increases.
3. There may be friction between the metal hatch and the opening.
4. Air pressure within the submarine has not been taken into account

Any of the two reasons or any other plausible explanation.

(c)
$P_1V_1 = P_2V_2$
$(1.1)(15) = (200)(V_2)$
$V_2 = 0.083$ m^3 (2 sf)

(d) The bubble <u>increases in volume</u>.
As the bubble rises to the surface, the water pressure around the bubble decreases. The <u>pressure inside the bubble is larger than the water pressure</u>, thus exerting a force outward.
As the volume of the bubble increases, the <u>air molecules in the bubble bombard the walls less per unit time</u>, thus the force exerted on the walls of the bubble decreases, by P = F/A, pressure inside the bubble drops.
The volume will expand until <u>the pressure inside the bubble is equal to surrounding water pressure</u> around the bubble.