F4 Physics Final Exam 2018-2019 Marking Schemes

Section A (35%)

1	2	3	4	5	6	7	8	9	10
D	B	B	A	D	C	A	B	C	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	C	C	B	B	B	A	A	D	A
21	**22**	**23**	**24**	**25**	**26**				
C	D	C	D	D	A				

Section B (65%)

1. (a) (i) $R\sin 28° = mg$

$R\sin 28° = 78 \times 9.81$ 1M

$R = 1630$ N 1A

(ii) $R\cos 28° = ma_c$

$1630\cos 28° = 78a_c$ 1M

$a_c = 18.4$ m s^{-2} 1A

(iii) $a_c = \dfrac{v^2}{r}$

$18.4 = \dfrac{v^2}{5}$ 1M

$v = 9.6$ m s^{-1} 1A

(b) $v = r\omega = 5 \times \dfrac{2\pi \times 24}{60}$ 1M

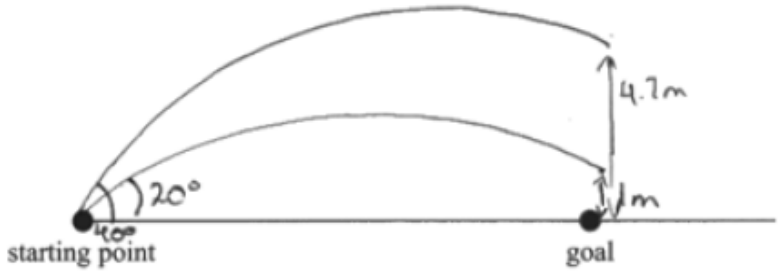
$= 12.6$ m s^{-1} 1A

(c) Child's mass is less than that of adult. 1A

The smaller the mass, the smaller the force the rider experiences since they experience the same acceleration. 1A 1A

2. (a) (i) The ball has landed before reaching the goal 1A

(ii)



2A

(b) (i) $11 = 27\cos 15°t$

$t = 0.422$ s — 1M

$s = 27\sin 15° \times 0.422 + \frac{1}{2}(-9.81)(0.422)^2 = 2.08$ m — 1M

The top of the ball on reaching the goal = 2.08 + 0.22 = 2.3 m < 2.4 m

Hence, the goal will be scored. — 1A

(ii) Air resistance is in the opposite direction to the ball's motion. — 1A

The ball will decelerate so the ball will not travel as far (Or this reduces the maximum height the ball reaches Or the ball is in the air for less time Or the ball will take longer to reach the goal) — 1A

3. (a) Convex lens — 1A

(b) $\frac{1}{u} + \frac{1}{-2u} = \frac{1}{6}$ — 1M

$u = 3$ cm — 1A

(c) Thicker lens have smaller focal length. — 1M

With the same object distance, magnification will be larger. — 1A

4. (a) Particle *P* is moving downwards. — 1A

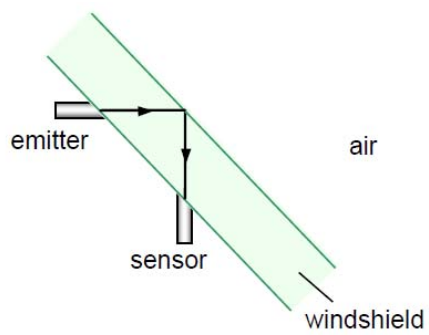
(b) $v = 0.14/2 = 0.7$ m s^{-1} — 1M

$f = \frac{v}{\lambda} = \frac{0.7}{0.04} = 17.5$ Hz — 1A

(c) distance $PQ = 14$ cm $= \frac{14}{4} = 3.5\lambda$ — 1M

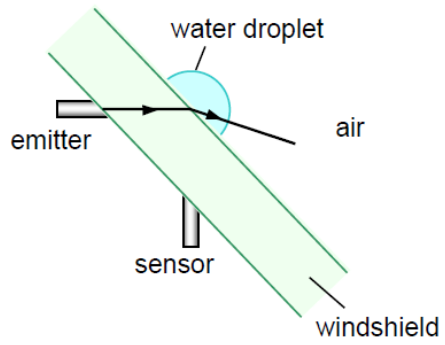
They vibrate in anti-phase — 1A

5. (a)



1A

(b)



1A

(c) glass-air interface: $c = \sin^{-1}(\frac{1}{1.71}) = 35.8°$ 1A

glass-water interface: $c = \sin^{-1}(\frac{1.33}{1.71}) = 51.1°$ 1A

Since the angle of incidence is 45°, total internal reflection will occur when the glass is dry but not when the glass is wet. 1A

6. (a) Push or pull the piston to a new position. 1A

Record the pressure p of the Bourdon gauge and the volume V of the gas in the syringe. 1A

Repeat with different volumes and take several sets of data. 1A

Plot p against $\frac{1}{V}$ and a straight line passing through the origin is expected. 1A

Precaution:

Push or pull the piston slowly to keep constant temperature.

Wait a while for the temperature to return to room temperature after pushing or pulling the piston. 1A

(b) The volume of gas in the rubber tubing cannot be measured. 1A

(c) Put the syringe in melting ice. 1A

7. (a) $Pt = mc\Delta T$

$P \times 400 = 2 \times 4200 \times (100 - 20)$ 1M

$P = 1680$ W 1A

(b) $Pt = ml$

$1680 \times 700 = 0.5 \times l$ 1M

$l = 2.35 \times 10^6$ J kg^{-1} 1A

8. (a) (i)

$$n = \frac{pV}{RT} = \frac{1.01\times10^5\times100\times10^{-6}}{8.31\times(20+273)} = 4.15\times10^{-3}$$

1M
1A

(ii)

$$pV = \frac{1}{3}Nm\overline{c_{rms}^{\ 2}}$$

$$1.01\times10^5\times100\times10^{-6} = \frac{1}{3}\times4.15\times10^{-3}\times0.006\times\overline{c_{rms}^{\ 2}}$$

1M

$$c_{rms} = 1100 \text{ m s}^{-1}$$

1A

OR

$$\frac{1}{2}m\overline{c_{rms}^{\ 2}} = \frac{3RT}{2N_A}$$

$$c_{rms} = \sqrt{\frac{3RT}{N_A m}} = \sqrt{\frac{3\times8.31\times(20+273)}{0.006}}$$

$$c_{rms} = 1100 \text{ m s}^{-1}$$

(b) (i) 1.01×10^5 Pa

1A

(ii)

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{h}{80+273} = \frac{20}{20+273}$$

1M

$$h = 24.1 \text{ cm}$$

1A

(iii)

$$\Delta KE = \frac{3}{2}nR\Delta T = \frac{3}{2}\times4.15\times10^{-3}\times8.31\times(80-20) = 3.10 \text{ J}$$

1M
1A

9. (a) $2100 - 640 - f = 2560\times0.4$

1M

$$f = 436 \text{ N}$$

1A

(b) $T - 436 = 960\times0.4$

1M

$$T = 820 \text{ N}$$

1A

(c) $F = mg\sin\theta + f_1 + f_2$

$$10000 = (1600+960)\times9.81\sin\theta + 640 + 436$$

1M

$$\theta = 20.8°$$

1A

10. (a) The trolley moves at constant velocity. Net force is zero. 1A

No applied force is acting on the trolley. So, there is no resistive force. 1A

(b) $0 = m_1 v_1 + m_2 v_2$

$0 = 1 \times 2.4 - 2v$ 1M

$v = 1.2 \text{ m s}^{-1}$ 1A

(c) $Ft = mv - mu$

$75 \times 0.05 = 1 \times v - 1 \times (-2.4)$ 1M

$v = 1.35 \text{ m s}^{-1}$ 1A

(d) Yes. 1A

The 1-kg trolley moves faster than 2-kg trolley and they move in the same direction. 1A