CARMEL DIVINE GRACE FOUNDATION SECONDARY SCHOOL
SECOND TERM EXAMINATION (2021-2022)
SECONDARY VI PHYSICS
MARKING SCHEME

Section A: Multiple-Choice Questions

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
D	C	D	B	A	D	C	D	B	A

11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
B	C	B	C	D	A	B	B	A	B

21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
C	C	D	A	C	D	A	C	A	A

31.	32.	33.
B	D	B

Section B: Conventional Questions

1. (a) Energy required
= energy for heating the mixture + energy for heating the bowl (with the lid) + coagulation energy
$= (0.27 + 0.06 \times 3)(2500)(65 - 25) + (0.25)(840)(65 - 25)$ 1M
= 53400 J 1A

(b) When steam condenses on the wall of the bowl, heat is released to heat up the bowl and 1A
thus the egg mixture. 1A

(c) (i) Pt = E ⇒ 1550t = 53400 1M
∴ t = 34.5 s 1A

(ii) A lot of steam escapes to the surroundings instead of condensing on the wall of the bowl. 1M

(d) Metal is a good conductor of heat. 1M

2. (a) By $p_1/T_1 = p_2/T_2$, the expected gas pressure
$p_2 = p_1T_2/T_1 = (1.0 \times 10^5)(80 + 273) / (25 + 273)$ 1M
$= 1.18 \times 10^5$ Pa 1A

(b) Wrong. The volume inside the rubber tubing is fixed throughout the experiment. This 1M
satisfies the fixed-volume condition, so this extra volume does not affect the result. 1M
The real reason is that the temperature of the gas inside the rubber tubing is lower than that inside the flask. (So, overall, the temperature of the gas is actually lower than the thermometer reading.) 1M
Hence, the gas pressure is lower than expected.

(c) (i) When the temperature increases, the gas molecules move faster. 1M

They hit the wall more frequently and vigorously. 1M

Therefore, the gas pressure increases.

(ii) Same y-intercept but a smaller slope. 1A

3. (a) Average acceleration = $\frac{v-u}{t}$ = $\frac{2.0-0.8}{1.3-0.9}$ 1M

= 3 m s^{-2} 1A

(b) Take forwards as positive. By $F = ma$,

$P - 50 = 55 \times 3$

$P = 215$ N

By Newton's third law of motion, the average force that his legs 1M

exert on the water is 215 N backwards. 1A

(c) Any two of the following:

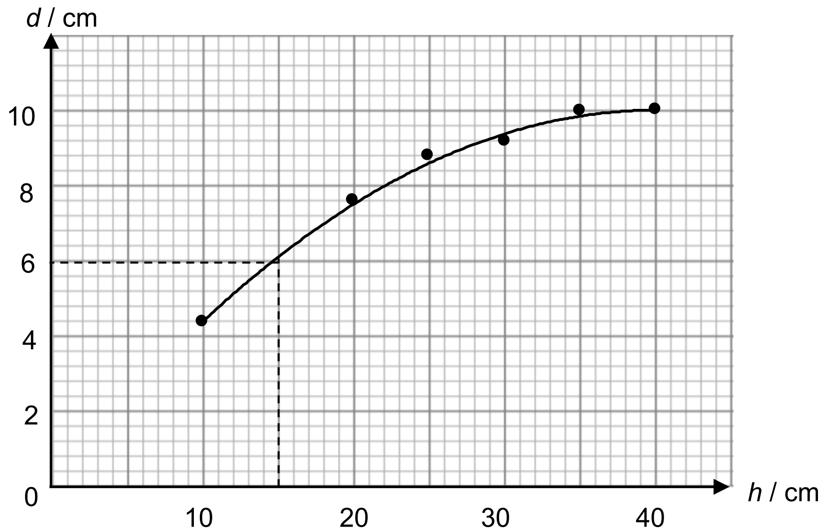
No forward force acts on the swimmer in that period.

The water resistance is greater when he brings his knees forwards.

The water resistance is greater when his body is tilted in that 1M

period. 1M

4. (a)



(Correct smooth curve) 1A

Diameter of crater = 6 cm 1A

(Accept 5.6 cm to 6.4 cm)

(b) Procedure:

Release a marble from a fixed height (e.g. 30 cm). 1M

Measure the diameter of the crater formed. 1M

Repeat with marbles of different masses. 1M

Plot a graph of diameter of the crater formed against the mass of marble. 1M

Precaution (any one): 1M

Level the sand between drops.

Repeat drops several times and take the average of the readings.

(Or other reasonable answers)

(c) Loss in PE = work done against resistive force

$mg(h + d) = fd$

$\Rightarrow f = \frac{mg(h+d)}{d} = \frac{(0.01)(9.81)(0.35+0.07)}{0.07}$ 1M

$= 0.589$ N 1A

(d) (i) $g = \frac{GM}{r^2} = \frac{(6.67\times10^{-11})(7.35\times10^{22})}{(1.74\times10^{6})^2}$ 1M

$= 1.62$ m s^{-2} 1A

(ii) The kinetic energy of the marble would be lower. 1A

5. (a) (i) Let R be the radius of the Earth. By ,

$GM = gR^2 = (9.81)(6\ 370\ 000)^2 \approx 3.9806 \times 10^{14}$ m^3 s^{-2} 1M

Let h be the height of the geostationary satellite above the Earth's surface.

$\frac{GMm}{(R+h)^2} = m\omega^2(R+h)$ 1M

$(R+h)^3 = \frac{GM}{\omega^2} = (3.9806 \times 10^{14}) \div \left(\frac{2\pi}{24 \times 3600}\right)^2$

Solving, we get h = 3.59×10^7 m. 1A

(ii) Microwave 1A

(iii) Time spent to transmit from London to Tim's house, t_1

$= \frac{36\ 500\ 000 \times 2}{3 \times 10^8}$

$= 0.243$ s 1A

(iv) His idea does not work. 1A

It is because ultrasounds cannot travel in vacuum / requires a medium to propagate. 1M

(b) (i) Total internal reflection 1A

(ii) The speed of light travelling in optical fibre, v

$= \frac{c}{n} = \frac{3 \times 10^8}{1.8} = 1.67 \times 10^8$ m s^{-1} 1M

Time spent to transmit from London to Sally's house, t_2

$= \frac{12\ 000\ 000}{1.67 \times 10^8} = 0.072$ s $< t_1$ 1M

So, Sally watches the goal first. 1A

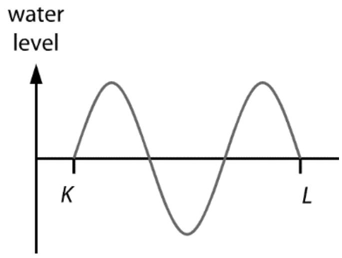
6. (a) (i) The path difference at J is 45 – 20 = 25 = 2.5 λ. (λ = 10 cm) 1A

Destructive interference occurs. 1A

(ii) (1)Two identical waves from S1 and S2, which travel at opposite directions, superpose along line KL and form a stationary wave. 1M

The water level along line KL will oscillate all the time. Thus his comment is incorrect. 1A

(2)



Correct waveform 1M

Correct number of nodes and antinodes 1M

(b) (i) Two independent light sources do not emit coherent light. 1M

No interference occurs. 1A

(ii) By $y = \frac{\lambda D}{a}$, we have $y \propto \lambda$ 1M

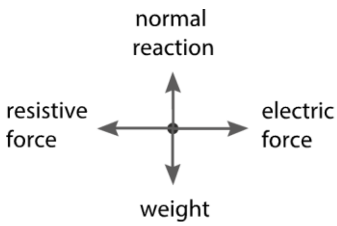
By $v = f\lambda$, we have $\lambda = \frac{v}{f} = \frac{c}{nf}$, thus $\lambda \propto \frac{1}{n}$ 1M

Combining the above results, we have $y \propto \frac{1}{n}$

$\frac{n_l}{n_a} = \frac{y_a}{y_l} = \frac{0.0055}{0.0035} = 1.571 \quad \Rightarrow \quad n_l \approx 1.57$ 1A

7. (a) The electric field is $V/d = 50/0.1 = 500$ V m^{-1}. 1A

(b) (i) 2A



(ii) The electric force on the fragment is constant. 1A

At the beginning, there is no resistive force. The fragment speeds up due to the electric force. 1M

As the fragment speeds up, the resistive force on the fragment increases. When these two forces are balanced, the fragment reaches a terminal speed. 1M

(c) The positions of the fragments depend on the duration of the run and the condition of the gel. The arrangement is to ensure the fragments in different samples are separated under the same conditions. 1M

(d) (i) Tracer *Y* 1A

A half-life of 3 days is long enough for the test to be completed while does not make the sample remain radioactive for too long. 1M

(ii) No. There is no source on the film. 1A

1A

8. (a) The resistance becomes larger. 1A

When the resistor is stretched, the wires becomes longer and thinner. By R = ρℓ / A, the resistance becomes larger. 1M

(b) (i) The equivalent resistance of the voltmeter and X can be calculated by

$$\frac{1}{R_{eq}} = \frac{1}{120} + \frac{1}{1000}$$ 1M

$$R_{eq} = 107.1\ \Omega$$

The voltmeter reading can be calculated by

$$\frac{V}{107.1} = \frac{6 - V}{120}$$

$$V = 2.830 \approx 2.83\ \text{V}$$ 1A

(ii) When the accelerometer accelerates towards the side of X, the beam curves towards the side of Y. 1M

X is being stretched and Y is being compressed. In other words, the resistance of X becomes larger while that of Y becomes smaller. 1M

Therefore, the p.d. across X becomes greater and the voltmeter reading should increase. 1M

(c) (i) 0 V 1A

(ii) As the voltmeter reading is positive, the potential at node b is higher than that at node d. This suggests that X has a smaller resistance. 1A

The beam curves towards the side of X and the accelerometer accelerates towards the side of Y. 1M

9. (a) (i) $x = 3$, $y = 36$ 1A

(ii) Energy released

= (234.9934 – 143.8923 – 88.8981 – 2 × 1.0087) × 931 1M

= 173 MeV 1A

(b) (i) Half-life is the time interval to reduce the number of undecayed nuclei / activity by half. 1M

(ii) Let k_{235} and k_{238} be the decay constants of U-235 and U-238 respectively. By $k = \frac{\ln 2}{t_{1/2}}$,

$$k_{235} = \frac{\ln 2}{7.04 \times 10^{8}} = 9.85 \times 10^{-10}\ \text{y}^{-1}$$

$$k_{238} = \frac{\ln 2}{4.49 \times 10^{9}} = 1.54 \times 10^{-10}\ \text{y}^{-1}$$ 1M

Since $N = N_0 e^{-k_{235}t}$ and $n = n_0 e^{-k_{238}t}$,

$$\frac{N}{n} = \frac{N_0 e^{-k_{235}t}}{n_0 e^{-k_{238}t}}$$

$$\frac{1}{138} = \frac{1}{32} e^{(k_{238} - k_{235})t}$$

$$t = \ln \frac{32}{138} \div (k_{238} - k_{235}) = 1.76 \times 10^{9}\ \text{yr}$$ 1M 1A

So, the natural fission reactor stopped fission by 1.76×10^{9} years.