

Physics 12
August 2007 — Form A
 Provincial Examination — Multiple-Choice Key

Cognitive Processes	Weightings	Question Types
K = Knowledge	10%	35 = Multiple Choice (MC)
U = Understanding	80%	6 = Written Response (WR)
H = Higher Mental Processes	10%	

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Vector Kinematics in Two Dimensions <i>and Dynamics and Vector Dynamics</i>	A, B C, D	9% 9%
2. Work, Energy and Power <i>and Momentum</i>	E F, G	6% 6%
3. Equilibrium	H	12%
4. Circular Motion <i>and Gravitation</i>	I J	8% 8%
5. Electrostatics	K, L	12%
6. Electric Circuits	M, N	12%
7. Electromagnetism	O, P	18%

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type	Question Source
1.	D	K	2	1	A1	MC	
2.	C	U	2	1	B2, A10	MC	
3.	B	U	2	1	A9	MC	
4.	D	K	2	1	C6	MC	
5.	B	U	2	1	C8, D3	MC	
6.	D	U	2	1	D4, 6	MC	
7.	B	U	2	1	D6	MC	
8.	C	U	2	2	E7, 10	MC	
9.	A	U	2	2	F1	MC	
10.	D	U	2	2	F4	MC	
11.	B	U	2	2	G3	MC	
12.	D	K	2	3	H4	MC	
13.	B	U	2	3	H3	MC	
14.	C	U	2	3	H5	MC	
15.	C	U	2	3	H11	MC	

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type	Question Source
16.	A	U	2	4	I4	MC	
17.	A	K	2	4	J2, B6	MC	
18.	A	U	2	4	J2, 3	MC	
19.	C	U	2	4	J8, 9	MC	
20.	B	H	2	4	J6, 10	MC	
21.	D	K	2	5	K8, L7	MC	
22.	D	U	2	5	K3	MC	
23.	C	U	2	5	K8	MC	
24.	C	U	2	5	L5	MC	
25.	B	U	2	5	L6	MC	
26.	C	U	2	6	M2	MC	
27.	D	U	2	6	M7	MC	
28.	C	U	2	6	M9	MC	
29.	B	U	2	6	M11	MC	
30.	D	U	2	7	P4	MC	
31.	C	U	2	7	O6	MC	
32.	B	U	2	7	O7	MC	
33.	B	U	2	7	O4	MC	
34.	C	U	2	7	P5	MC	
35.	B	U	2	7	P4	MC	

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Provincial Examination — Written-Response Key

Cognitive Processes	Weightings	Question Types
K = Knowledge	10%	35 = Multiple Choice (MC)
U = Understanding	80%	6 = Written Response (WR)
H = Higher Mental Processes	10%	

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Vector Kinematics in Two Dimensions <i>and Dynamics and Vector Dynamics</i>	A, B C, D	9 % 9 %
2. Work, Energy and Power <i>and Momentum</i>	E F, G	6 % 6 %
3. Equilibrium	H	12 %
4. Circular Motion <i>and Gravitation</i>	I J	8 % 8 %
5. Electrostatics	K, L	12 %
6. Electric Circuits	M, N	12 %
7. Electromagnetism	O, P	18 %

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type	Question Source
1.	–	U	5	2	G3	WR	
2.	–	U	5	3	H11	WR	
3.	–	U	6	5	K8	WR	
4.	–	U	5	7	O5; H3	WR	
5.	–	H	5	1	A10; B2	WR	
6.	–	H	4	6	P10	WR	

Physics 12

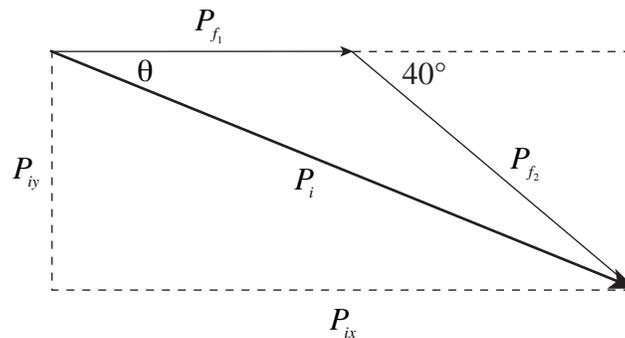
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Provincial Examination — Scoring Guide

1. (5 marks)

A 10 kg curling stone is sliding along the ice when it hits a stationary 15 kg bucket of sand. After the collision, the curling stone's velocity is 3.0 m/s east, and the bucket has a velocity of 2.2 m/s, 40° S of E.

What direction was the curling stone moving before the collision?



$$P_{ix} = 30 + 33 \cos 40^\circ = 55.3 \quad \leftarrow \text{2 marks}$$

$$P_{iy} = 33 \sin 40^\circ = 21.2 \quad \leftarrow \text{1 mark}$$

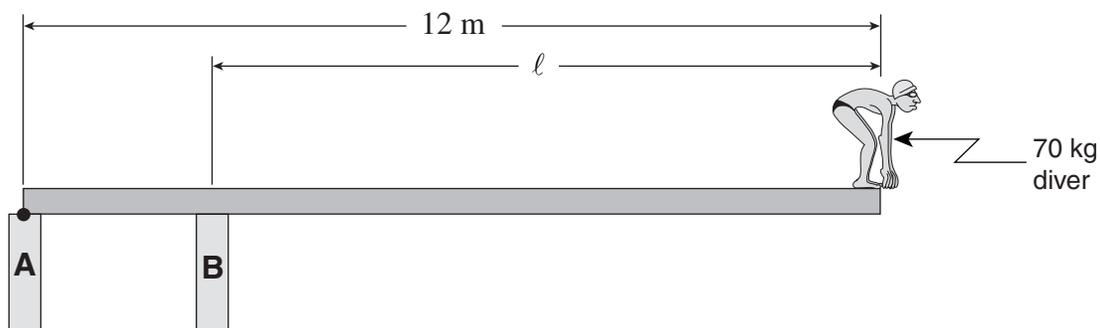
$$\tan \theta = \frac{21.2}{55.3} \quad \leftarrow \text{1 mark}$$

$$\theta = 21^\circ \text{ S of E (} 69^\circ \text{ E of S)} \quad \leftarrow \text{1 mark}$$

Note to markers: Consider giving full marks for 21° below the horizontal, 69° from the vertical.

2. (5 marks)

An 80 kg, 12 m uniform diving board in static equilibrium is shown below. Support A is providing a 3000 N force directed downward on the board.



Determine the force provided by support B and the distance ℓ .

$$\Sigma F_y = 0 = -3000 + -70(9.8) + F_B + -80(9.8) \quad \leftarrow 1 \text{ mark}$$

$$F_B = 4470 \text{ N} = 4.47 \times 10^3 \text{ N} \quad \leftarrow 1 \text{ mark}$$

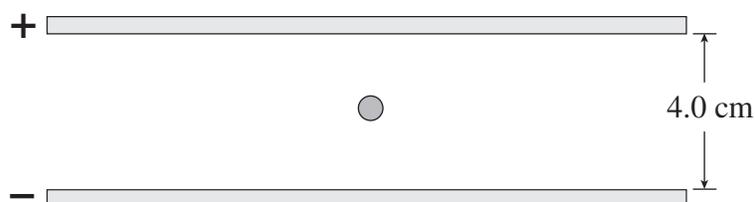
$\Sigma \tau = 0$ taken from the right end of the beam

$$0 = 3000(12) + 80(9.8)(6.0) + -4470(\ell) \quad \leftarrow 2 \text{ marks}$$

$$\ell = 9.11 \text{ m} \quad \leftarrow 1 \text{ mark}$$

3. (6 marks)

A small negatively charged sphere with a mass of 4.5×10^{-6} kg is suspended electrostatically between oppositely charged horizontal parallel plates as shown in the diagram. A potential difference of 360 V is required across the plates to hold the charged sphere stationary.



Calculate the magnitude of the charge on the sphere.

$$E = \frac{V}{d} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$E = \frac{F}{q} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$\therefore \frac{F}{q} = \frac{V}{d} \quad \leftarrow 1 \text{ mark}$$

$$\therefore q = \frac{Fd}{V} = \frac{mgd}{V} = \frac{4.5 \times 10^{-6} \times 9.8 \times 0.040}{360} \quad \leftarrow 1 \frac{1}{2} \text{ marks}$$

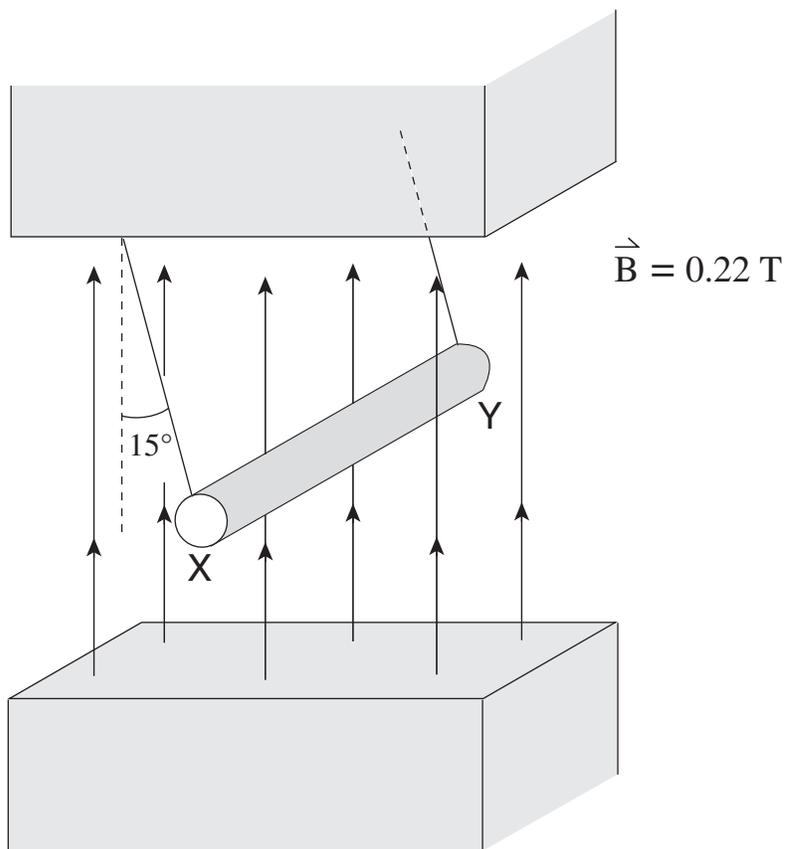
$$q = 4.9 \times 10^{-9} \text{ C} \quad \leftarrow \frac{1}{2} \text{ mark}$$

A sphere with a smaller mass carrying an equal but opposite charge is now placed between the plates. Using physics principles, explain the changes that must be made to the plates to keep the new sphere stationary.

A sphere carrying the opposite charge can only be suspended if the electric field direction is reversed. This means that the polarity of the plates must be switched. If the sphere is lighter then the electrostatic force required is smaller. This means that the potential difference which creates the electric field between the parallel plates can be reduced. (2 marks)

4. (5 marks)

An 18 cm long metal rod, of mass 35 g, is suspended from the ceiling with light wire. A uniform 0.22 T magnetic field is directed vertically upward. When there is a current in the rod, it swings outward 15° to the vertical as shown.



What are the magnitude and the direction of the current in the rod?

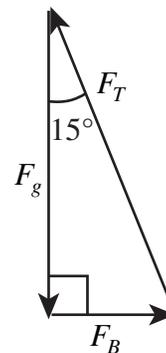
$$\tan \theta = \frac{F_{mag}}{F_g}$$

$$mg \tan \theta = BIl \quad \leftarrow 3 \text{ marks}$$

$$0.035(9.8) \tan 15^\circ = 0.22 I(0.18) \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$I = 2.3 \text{ A} \quad \leftarrow \frac{1}{2} \text{ mark}$$

The current is directed into the page. $\leftarrow 1 \text{ mark}$



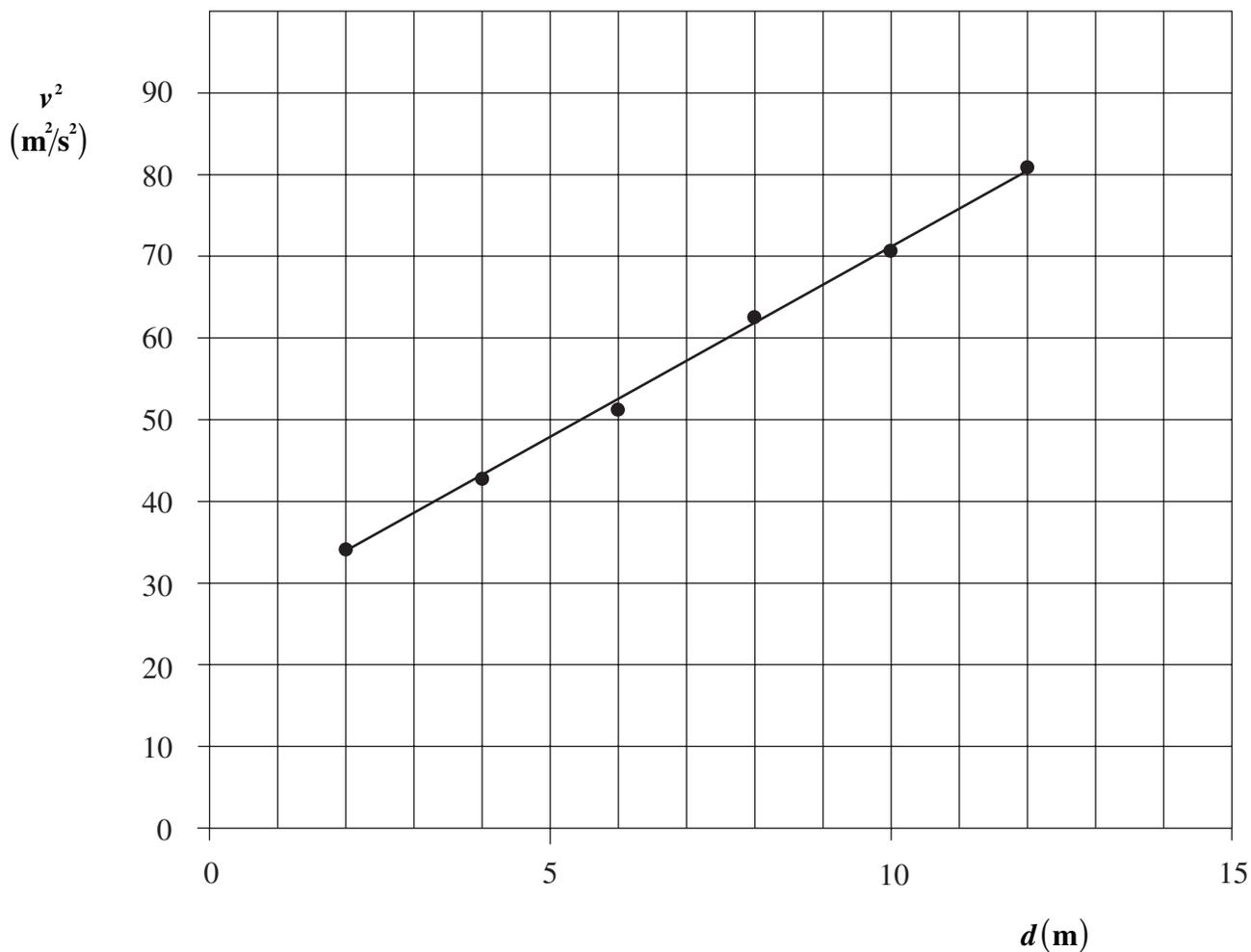
5. (5 marks)

A student measures the final speed of an accelerating car at various displacements. The data collected is shown below.

FINAL SPEED (m/s)	v^2	DISPLACEMENT (m)
5.9	34.8	2.0
6.5	42.3	4.0
7.2	51.8	6.0
7.9	62.4	8.0
8.4	70.6	10.0
9.0	81.0	12.0

Plot a graph of the final speed squared, v^2 , versus the displacement, d , of the car on the graph below.

Graph of v^2 vs d



Determine the slope of the line of best fit to the data and state what the slope represents.
Extend the line to the y-axis and use the y-intercept to determine the initial speed of the car.

Slope calculation:

$$\begin{aligned} m &= \frac{\Delta v^2}{\Delta d} \\ &= \frac{81 - 42}{12 - 4.0} \\ &= 4.8 \text{ m/s}^2 \end{aligned}$$

Slope = $2 \times$ acceleration of the car ← **2 marks**

$$y - \text{intercept} = 24 \text{ m}^2/\text{s}^2$$

$$\therefore v_i = (24)^{\frac{1}{2}} = 4.9 \text{ m/s} \quad \leftarrow \text{1 mark}$$

6. (4 marks)

A motor and a light bulb are connected in series with a battery. Using principles of physics, explain why the light bulb gets brighter when the motor is prevented from spinning.

When the motor is prevented from spinning, it no longer generates a back emf opposing the battery. (2 marks) Therefore the current increases (1 mark). This increased current causes the bulb brightness to increase. (1 mark)