

AUGUST 2005 PHYSICS 12 PROVINCIAL EXAMINATION

PART A: MULTIPLE CHOICE

1. Which of the following correctly applies to a projectile in the absence of friction?

- The vertical velocity is changing.
- The horizontal velocity is changing.
- The vertical acceleration is changing.
- The horizontal acceleration is changing.

2. An 1800 kg car initially travelling at 15 m/s brakes to avoid hitting another car. The car accelerates at -1.9 m/s^2 while braking to a stop. How far does the car travel during its acceleration?

A. 29 m B. 59 m C. 120 m D. 180 m

3. A 15 kg rock is projected horizontally from a very high cliff at a speed of 65 m/s as shown. What is the speed of the rock after it has fallen a vertical distance of 35 m?

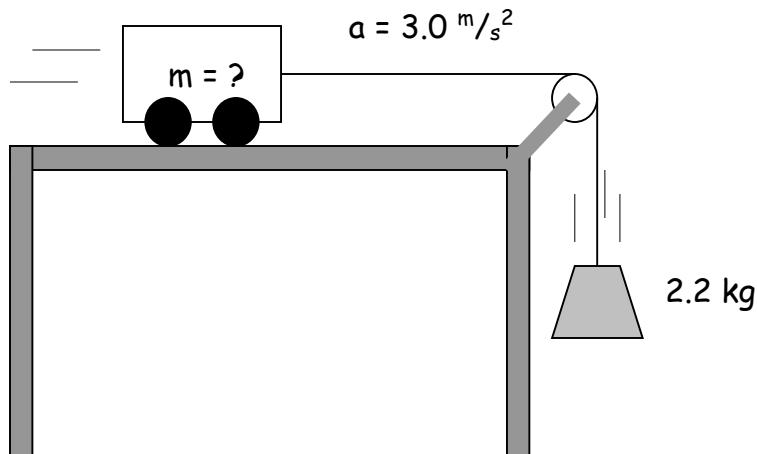
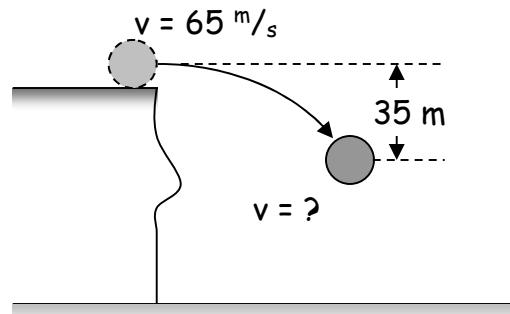
A. 26 m/s B. 59 m/s C. 65 m/s D. 70 m/s

4. Which of the following is equal to the gravitational field strength?

A. F_g B. $\frac{m}{F_g}$ C. $\frac{F_g}{m}$ D. $F_g \times m$

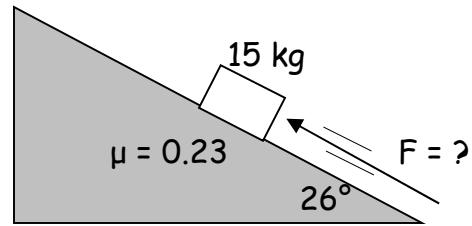
5. A cart of unknown mass is attached to a 2.2 kg mass hanging over the edge of a table as shown. The cart accelerates at 3.0 m/s^2 . (Ignore friction.) What is the mass of the cart?

A. 1.2 kg B. 5.0 kg C. 6.6 kg D. 7.2 kg

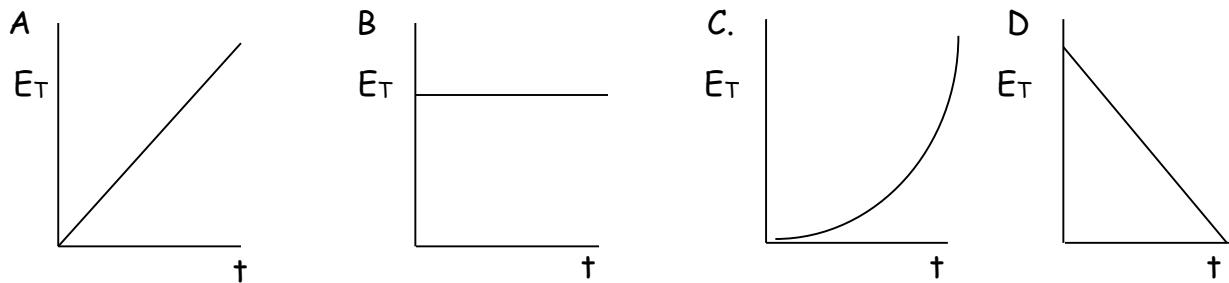


6. What force F applied parallel to the incline would make the 15 kg block shown below move at a constant speed up the incline?

A. 30 N B. 34 N
C. 64 N D. 95 N



7. A ball is dropped from a tree and falls to the ground. Which of the following best represents the ball's total energy, E_T , as it falls?

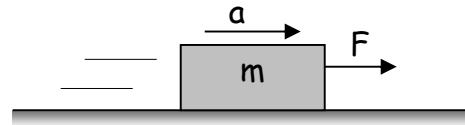


8. A 45 kg steel ball is projected vertically with an initial speed of 280 m/s . While the ball is rising, $8.5 \times 10^5 \text{ J}$ of heat energy are produced due to air friction. What is the maximum height reached by the ball?

A. 1900 m B. 2100 m C. 4000 m D. 5900 m

9. The force F shown below is pulling the mass m over a frictionless surface with an acceleration of a . Which of the following is equal to the mass's rate of change of momentum?

A. F B. $\frac{F}{a}$ C. $\frac{F}{m}$ D. Fa



10. A 5.0 kg ice block is sliding along a smooth floor at 1.0 m/s west when a 0.20 N force directed east acts on it for 4.0 s . What is the magnitude of the block's final momentum?

A. 0.80 kgm/s B. 4.2 kgm/s C. 5.0 kgm/s D. 5.8 kgm/s

11. A 1.0 kg physics puck is at rest when a small explosion breaks it into three pieces. A 0.50 kg piece goes north at 10 m/s and a 0.30 kg piece goes east at 20 m/s . What is the magnitude of the momentum of the third piece?

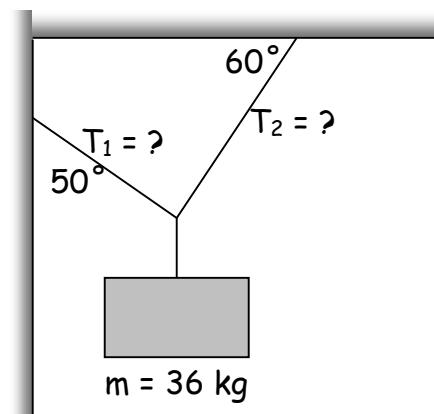
A. 1.0 kgm/s B. 3.3 kgm/s C. 7.8 kgm/s D. 11 kgm/s

12. Which of the following demonstrates the application of torque?

- A. Pulling a block across a floor
- B. Pushing a block up an incline
- C. Using a screwdriver to turn a screw
- D. Stopping a block from sliding down an incline

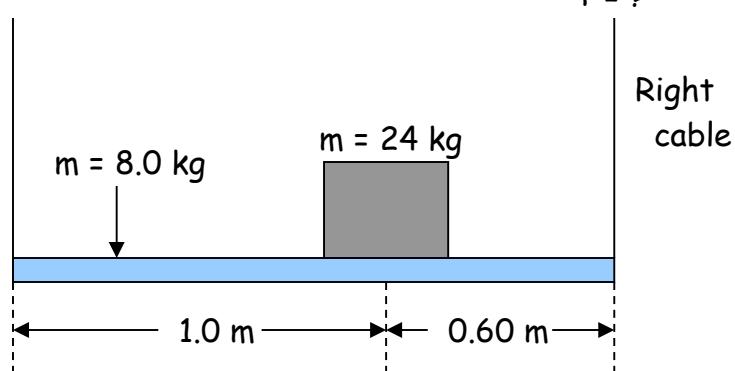
13. What are the tensions T_1 and T_2 in the two ropes holding the 36 kg mass as shown?

	Tension T_1	Tension T_2
A.	180 N	180 N
B.	180 N	270 N
C.	350 N	180 N
D.	350 N	350 N



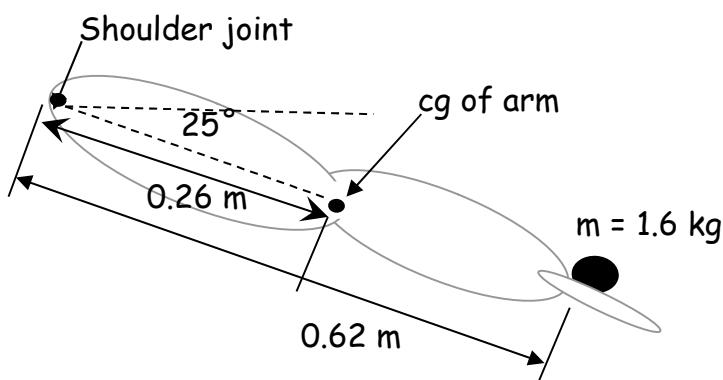
14. Two cables are used to support a 24 kg mass on a 1.6 m long 8.0 kg uniform horizontal beam as shown. What is the tension T in the right cable?

- A. 130 N
- B. 150 N
- C. 190 N
- D. 300 N



15. A 1.6 kg ball is held in the hand of a fully extended 11.2 kg arm as shown. (cg = centre of gravity) What is the total torque about the shoulder joint due to the ball and to this arm?

- A. 17 Nm
- B. 19 Nm
- C. 35 Nm
- D. 38 Nm



16. A small spider is accidentally taking a ride on a CD rotating with a period T . Its centripetal acceleration is 10 m/s^2 . The CD player is turned off and the disc slows down. What is the spider's centripetal acceleration when the disc has slowed so the period is $2T$?

A. 2.5 m/s^2

B. 5.0 m/s^2

C. 20 m/s^2

D. 40 m/s^2

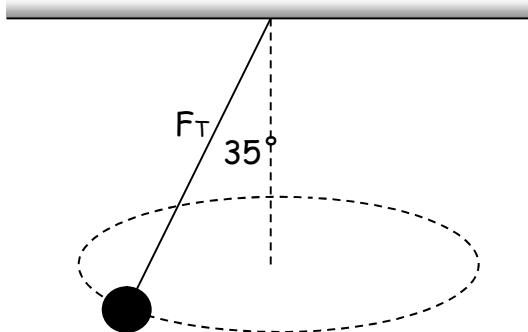
17. The 2.5 kg lead mass shown to the right is moving in a horizontal circle. The tension in the line is 30 N. What is the centripetal force on the lead mass?

A. 17 N

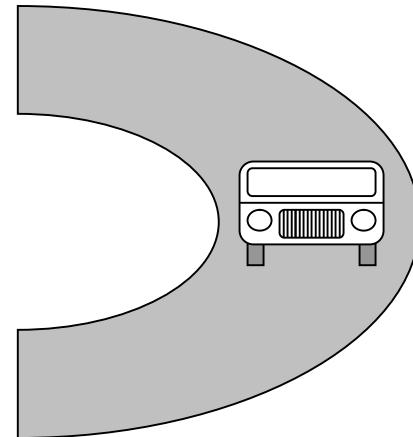
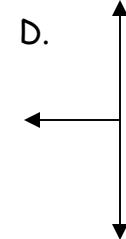
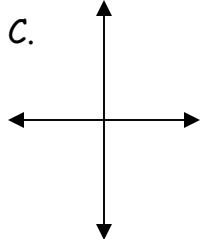
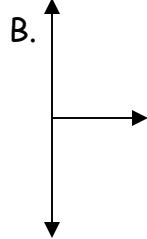
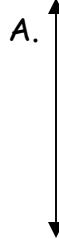
B. 25 N

C. 30 N

D. 55 N



18. A car is going around a curve at constant speed on a level road as shown in the diagram to the right. Which of the following free body diagrams shows the forces acting on the car?



19. A satellite is in a circular orbit around a planet. Which of the following describes the magnitude of the force due to gravity on the satellite as it moves around the planet?

A. constant

B. increasing

C. decreasing

D. increasing then decreasing

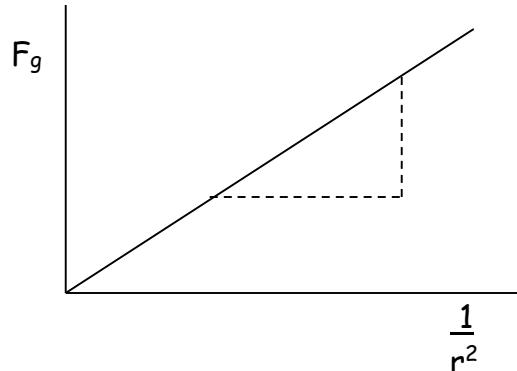
20. A planet has a larger gravitational field strength on its surface than does the earth. Which of the following is a possible comparison of this planet's mass and radius with Earth's?

	Mass	Radius
A.	larger	equal
B.	equal	larger
C.	smaller	equal

D.	smaller	larger
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21. The force due to gravity between two masses (m_1 and m_2) is determined for several separation distances. This data is then used to create the graph below. What is the slope of this graph?

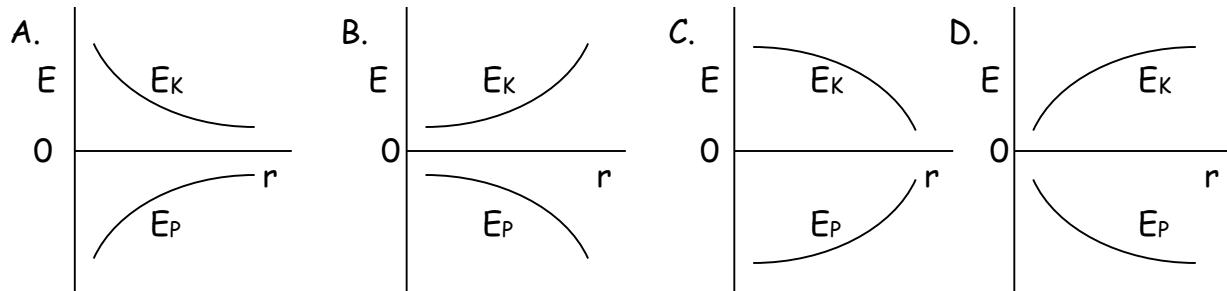
A. G
 B. $m_1 m_2$
 C. $\frac{m_1 m_2}{G}$
 D. $G m_1 m_2$



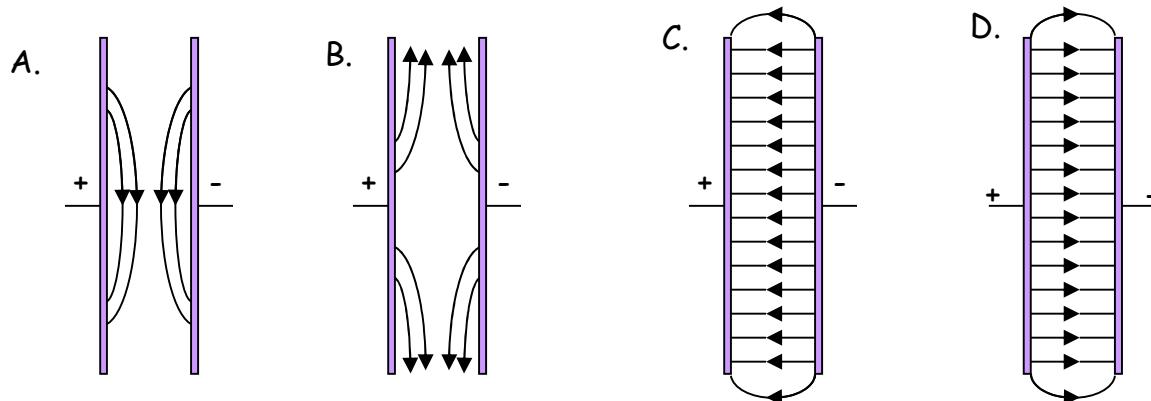
22. What is the speed of a 500 kg satellite orbiting the moon at distance of 2.5×10^6 m from the moon's centre?

A. 0.89 m/s
 B. 20 m/s
 C. $1.4 \times 10^3 \text{ m/s}$
 D. $3.1 \times 10^4 \text{ m/s}$

23. A mass is launched from the surface of a large moon at high speed. Which of the following graphs shows the potential and kinetic energies of the mass as it moves away from the moon?



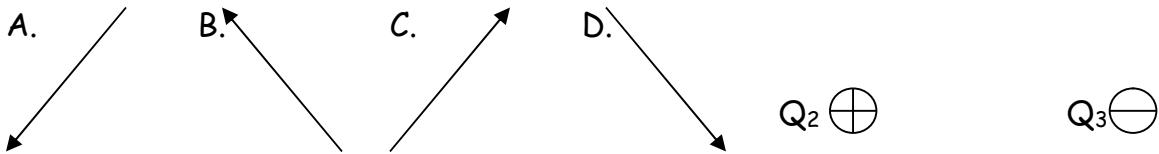
24. Which diagram best illustrates the electric field between oppositely charged parallel plates?



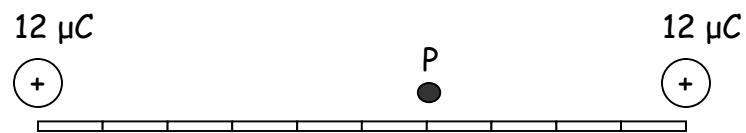
25. Three charges of identical magnitude are arranged as shown.

Q_1

What is the direction of the electric force on Q_2 ?



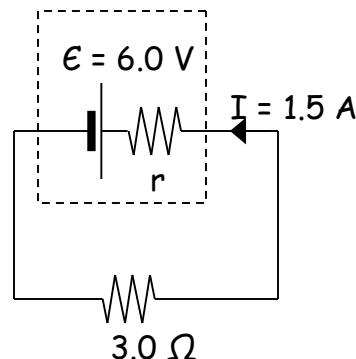
26. Identical $12 \mu C$ charges are placed at the ends of a metre stick. What is the electric potential at point P at the 60 cm mark on the metre stick?



A. 9.0×10^4 V B. 3.8×10^5 V C. 4.5×10^5 V D. 9.8×10^5 V

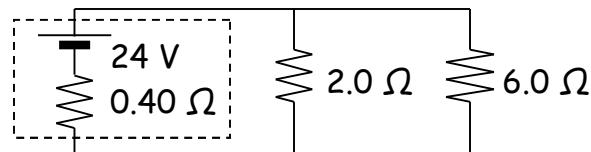
27. What is the internal resistance of the battery if it delivers 1.5 A when connected to a 3.0Ω external load?

A. 1.0Ω
B. 3.0Ω
C. 4.0Ω
D. 7.0Ω



28. In the circuit to the right, what is the current through the 2.0Ω resistor?

A. 9.5 A B. 10 A
C. 12 A D. 13 A



29. Which set groups the three common household electrical appliances in increasing order of rate of energy consumption while operating?

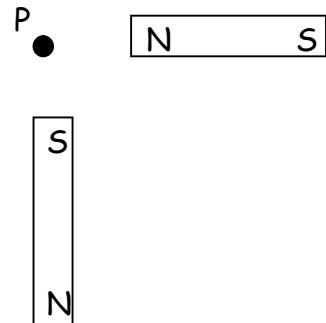
Increasing Rate of Energy Consumption		
A.	desktop computer	toaster
B.	desktop computer	oven
C.	toaster	oven
D.	toaster	desktop computer

30. In a step-down transformer, which of the following is greater in the secondary than in the primary?

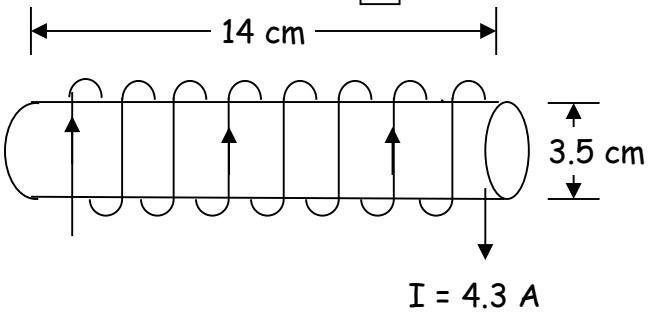
A. power B. current C. voltage D. number of turns

31. Two identical bar magnets are placed as shown. What is the direction of the magnetic field at P?

A.  B.  C.  D. 

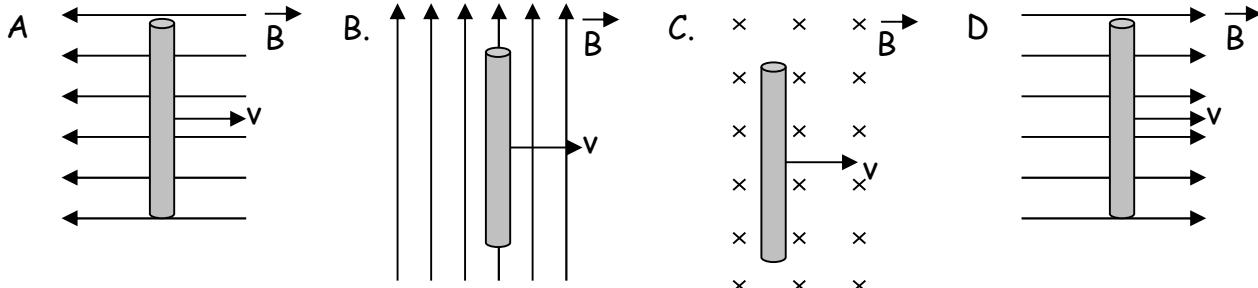


32. A current of 4.3 A flows through a solenoid. The 620-turn solenoid is 14 cm long and has a 3.5 cm diameter. What are the direction and magnitude of the magnetic field inside the solenoid?

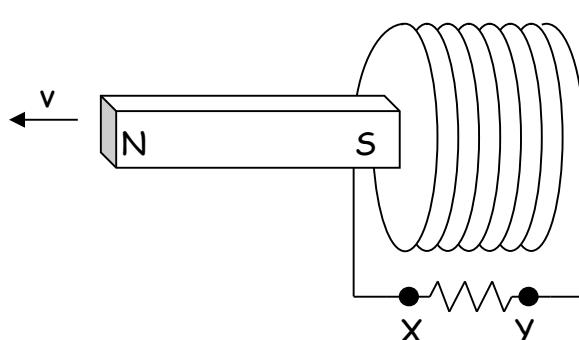


	Direction of Magnetic Field	Field Strength (T)
A.	left	2.4×10^{-2}
B.	left	9.6×10^{-2}
C.	right	2.4×10^{-2}
D.	right	9.6×10^{-2}

33. A conductor is moved to the right through four magnetic fields as shown below. In which case will the largest emf be generated?

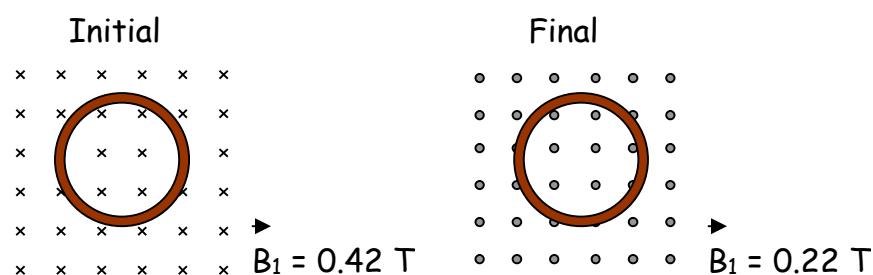


34. A bar magnet is moved away from a coil as shown. What is the direction of the current through the resistor and the polarity of the left end of the coil?



	Direction of Current through the Resistor	Polarity of Left end of Coil
A.	X to Y	North
B.	X to Y	South
C.	Y to X	North
D.	Y to X	South

35. A 200-turn coil has a 15.2 V potential difference induced in it when the magnetic field changes from 0.42 T to 0.22 T in the opposite direction in 3.2×10^{-2} s.



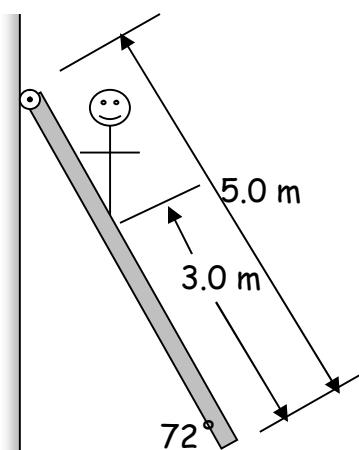
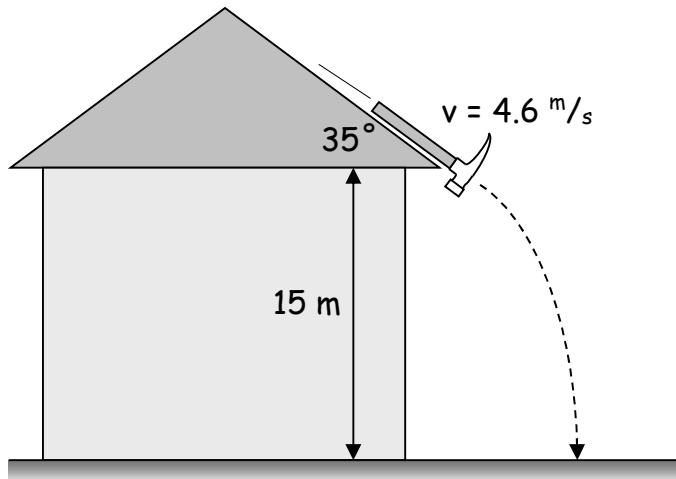
What is the radius of this coil?

A. 3.5×10^{-2} m B. 5.1×10^{-2} m C. 5.9×10^{-2} m D. 6.2×10^{-2} m

PART B: WRITTEN RESPONSE

1. A hammer slides down a roof sloped at 35° reaching a speed of 4.6 m/s before falling off.

How much time does it take to fall the 15 m to the ground? (5 marks)



2. A 65 kg man is 3.0 m up a 5.0 m, 16 kg ladder leaning against a smooth wall at an angle of 72° as shown to the left.

What minimum force of friction between the ladder and the floor is required to keep the ladder from sliding? (5 marks)

3. Alpha particles with a mass of $6.6 \times 10^{-27} \text{ kg}$ and a charge of $3.2 \times 10^{-19} \text{ C}$ are fired towards each other from a great distance.

$$\text{m} = 6.6 \times 10^{-27} \text{ kg}$$

$$Q = 3.2 \times 10^{-19} \text{ C}$$

$$\text{m} = 6.6 \times 10^{-27} \text{ kg}$$

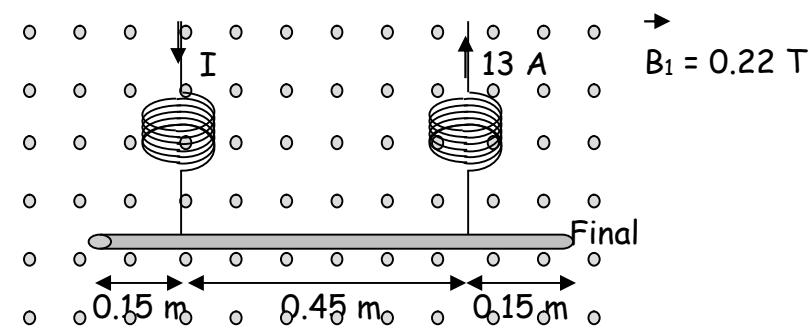
$$Q = 3.2 \times 10^{-19} \text{ C}$$

a) If they each have a speed of $2.5 \times 10^6 \text{ m/s}$ to start with, what will be their minimum separation distance? (4 marks)

b) Using energy principles, explain why the particles do not come any closer than this minimum separation distance. (2 marks)

4. A 0.75 m metal rod is suspended as shown. A current of 13 A then flows as indicated.

a) Is the tension in the springs increased or decreased? (1 mark)



b) How much does the tension change? (4 marks)

5. An experiment was performed on the surface of an asteroid. A mass was dropped from various heights and the time taken to fall was recorded.

d (m)	t (s)	$t^2 (\text{s}^2)$
0	0	
0.50	1.31	
0.70	1.56	
0.90	1.77	
1.20	2.05	
1.30	2.15	

a) Plot a straight line graph of d vs. t^2 . (2 marks)

b) From your straight line graph, determine the slope of the line. (Include units.) (1 mark)

c) What is the acceleration due to gravity on the surface of this asteroid? (2 marks)

6. When checked with a voltmeter, an old 6 V lantern battery shows the expected reading of 6.0 V. However, the battery fails to light a low resistance light bulb. Identify the property of the battery that must have changed as it aged.

Explain why this change to the property results in the bulb no longer lighting. (4 marks)

Physics 12 August 2005 Provincial Examination ANSWER KEY / SCORING GUIDE

PART A: Multiple Choice (each question worth TWO marks)

1. A	6. D	11. C	16. A	21. D	26. C	31. A
2. B	7. B	12. C	17. A	22. C	27. A	32. A
3. D	8. B	13. B	18. D	23. A	28. A	33. C
4. C	9. A	14. C	19. A	24. D	29. A	34. A
5. B	10. B	15. C	20. A	25. D	30. B	35. A

Multiple Choice = 70 marks

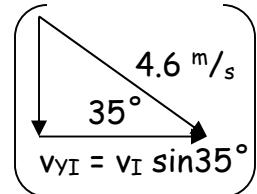
PART B: Written Response = 30 marks

$$1. v_{yF}^2 = v_{yI}^2 + 2ad_y$$

$$v_{yF}^2 = (-4.6 \text{ m/s} \sin 35^\circ)^2 + 2(-9.8 \text{ m/s}^2)(-15 \text{ m})$$

$$v_{yF} = -17.3 \text{ m/s}$$

3 marks



$$t = \frac{\Delta v_y}{g}$$

$$= \frac{-17.3 \text{ m/s} - (-4.6 \text{ m/s} \sin 35^\circ)}{-9.8 \text{ m/s}^2}$$

$$t = 1.5 \text{ s}$$

2 marks

$$2. \sum \tau = 0$$

$$\sum \tau_C = \sum \tau_{CC}$$

1 mark

$$F_{wdw} \sin \theta_W = F_M d_M \sin \theta_M + F_L d_L \sin \theta_L$$

$$F_w = \frac{F_P d_P \sin \theta_P + F_L d_L \sin \theta_L}{d_w \sin \theta_W}$$

$$F_w(5.0 \text{ m}) (\sin 72^\circ) = (65 \text{ kg})(9.8 \text{ m/s}^2)(3.0 \text{ m}) (\sin 72^\circ) + (16 \text{ kg})(9.8 \text{ m/s}^2)(2.5 \text{ m}) (\sin 18^\circ)$$

2 marks

$$F_w(4.755 \text{ m}) = 590.53 \text{ N} + 121.13 \text{ N}$$

1 mark

$$F_F = F_w = \frac{711.66 \text{ N}}{4.755 \text{ m}}$$

$$F_F = 150 \text{ N}$$

1 mark

3. $\Delta E_P = -\Delta E_K$ 1 mark

$$\begin{aligned}\Delta E_K &= 0 - 2\left(\frac{1}{2}mv^2\right) \\ &= -2\left(\frac{1}{2}\right)(6.6 \times 10^{-27} \text{ kg})(2.5 \times 10^6 \text{ m/s})^2 \\ &= -4.13 \times 10^{-14} \text{ J}\end{aligned}$$

$\Delta E_P = -4.13 \times 10^{-14} \text{ J}$ 1 mark

$kQ_1Q_2 = 4.13 \times 10^{-14} \text{ J}$ 1 mark

$$\begin{aligned}r_{\min} &= \frac{(9.0 \times 10^{-9} \text{ N/m}^2 \text{ C}^2)(3.2 \times 10^{-19} \text{ C})^2}{4.13 \times 10^{-14} \text{ J}} \\ &= 2.2 \times 10^{-14} \text{ m} \quad \frac{1}{2} \text{ marks}\end{aligned}$$

b) As the charged particles approach each other kinetic energy is transformed into electric potential energy. **(1 mark)** At the minimum separation distance the electric potential energy is equal to the initial kinetic energy. Additional kinetic energy would have been needed to bring the particles any closer. **(1 mark)**

4. a) The tension in the springs will be increased. 1 mark

b) How much does the tension change? **(4 marks)**

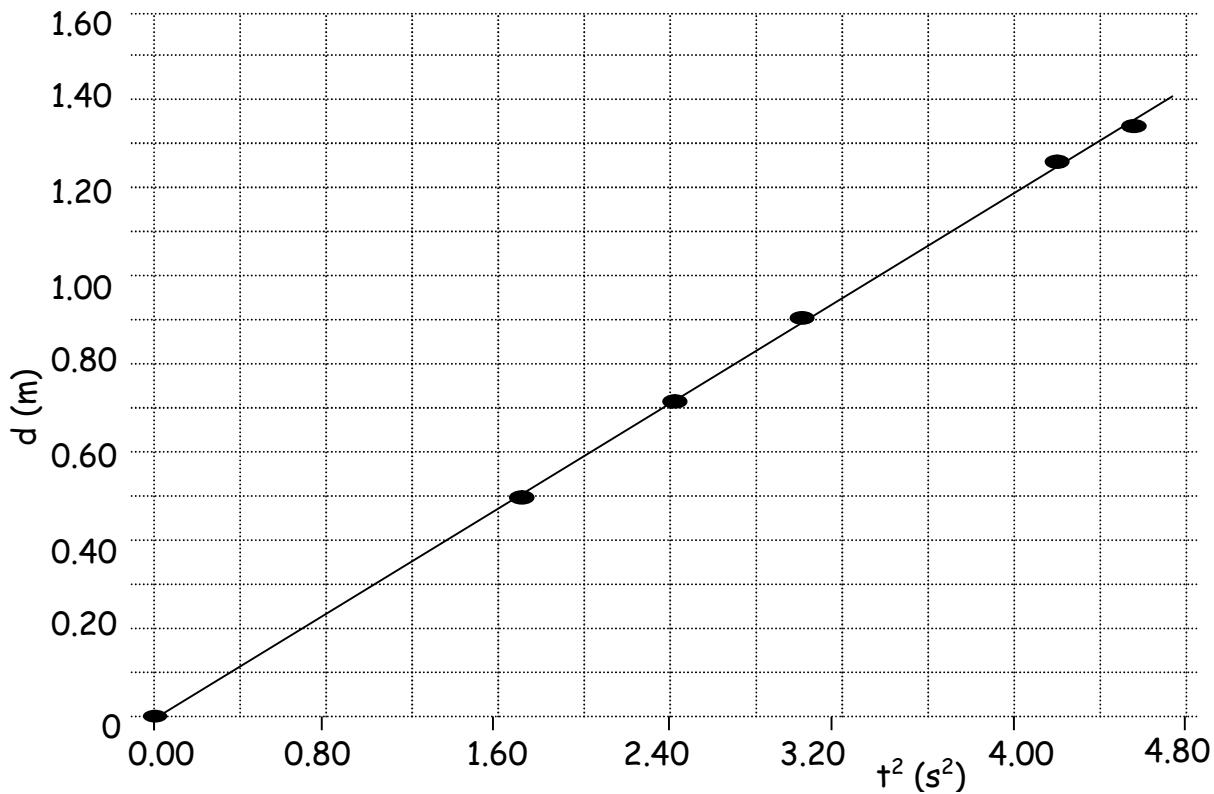
$$\begin{aligned}F &= BIL & 1 \text{ mark} \\ &= (0.22 \text{ T})(13 \text{ A})(0.45 \text{ m}) & 2 \text{ marks}\end{aligned}$$

$F = 1.3 \text{ N}$ 1 mark

5.

$d \text{ (m)}$	$t \text{ (s)}$	$t^2 \text{ (s}^2\text{)}$
0	0	0
0.50	1.31	1.72
0.70	1.56	2.43
0.90	1.77	3.13
1.20	2.05	4.20
1.30	2.15	4.62

a) (2 marks)



b) slope = $\frac{\Delta d}{\Delta t^2} \approx 0.28 \text{ m/s}^2$ 1 mark

c) $d = \frac{1}{2}at^2$

$d = (0.28 \text{ m/s}^2)t^2$

then $\frac{1}{2}at^2 = 0.28 \text{ m/s}^2$

$a = 0.56 \text{ m/s}^2$ 2 marks

(Allocate one mark for 0.28 m/s^2 only.)

6. Increased resistance. (1 mark)

The old battery has an increased internal resistance. (1 mark) When combined with the bulb's resistance, the circuit current, \mathcal{E}/RT will be too low to light the bulb. (2 marks)