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**PHYSICS
HIGHER LEVEL
PAPER 1**

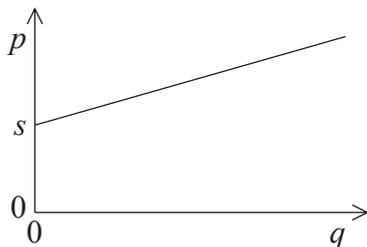
Tuesday 13 November 2012 (afternoon)

1 hour

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A clean copy of the **Physics Data Booklet** is required for this paper.
- The maximum mark for this examination paper is [40 marks].

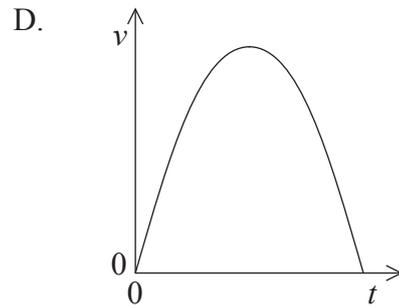
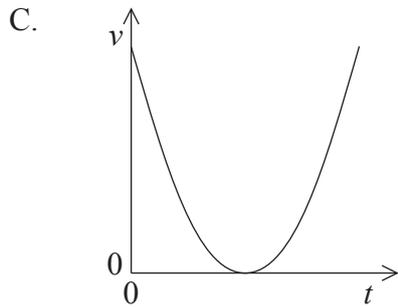
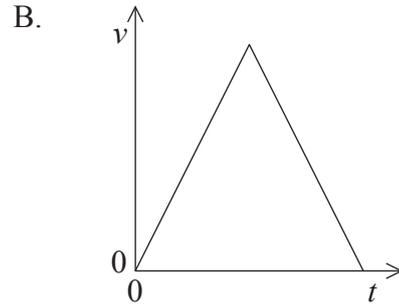
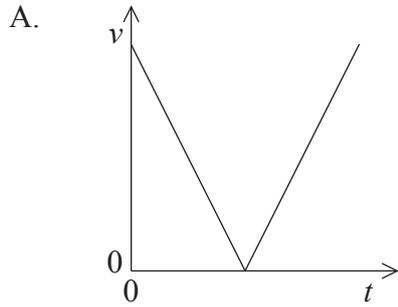
1. The graph shows the relationship between two quantities p and q . The gradient of the graph is r and the intercept on the p axis is s .



Which of the following is the correct relationship between p and q ?

- A. $p = sq + r$
- B. $p = rq + s$
- C. $p = rq - s$
- D. $p = rs + q$
2. The acceleration of free fall g is determined by the relationship $g = \frac{4\pi^2 l}{t^2}$. The uncertainty in the value of l is 2% and the uncertainty in the value of t is 5%. What is the uncertainty in g ?
- A. 3%
- B. 7%
- C. 8%
- D. 12%
3. Three coplanar forces of 5 N, 6 N and 7 N act on an object. Which force could **not** be the resultant of these three forces?
- A. 0 N
- B. 11 N
- C. 13 N
- D. 19 N

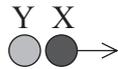
4. An object is thrown upwards leaving the thrower's hand at time $t=0$. Which graph shows how speed v varies with t as the object rises and falls?



5. A ball of mass m travels horizontally with speed v before colliding with a vertical wall. The ball rebounds at speed v in a direction opposite to its initial direction. What is the magnitude of the change in momentum of the ball?

- A. 0
- B. $\frac{mv}{2}$
- C. mv
- D. $2mv$

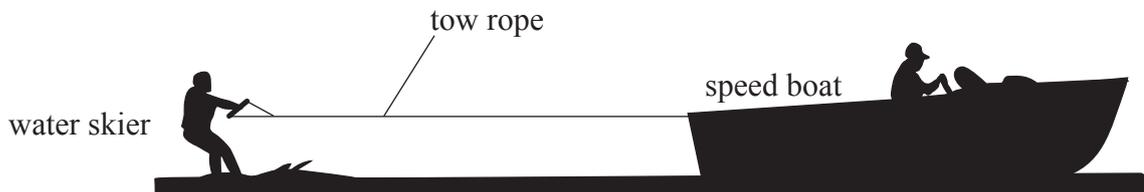
6. Balls X and Y are at the same height. X is projected horizontally at the same time that Y is dropped. Y is the same size as X but has half its mass.



————— ground

Ignoring air resistance, which statement is **true**?

- A. Y will hit the ground before X.
 - B. Y will hit the ground after X.
 - C. Y will hit the ground at the same time as X.
 - D. The outcome can only be determined if the initial speed of X is known.
7. A speed boat tows a water skier so that the skier accelerates.



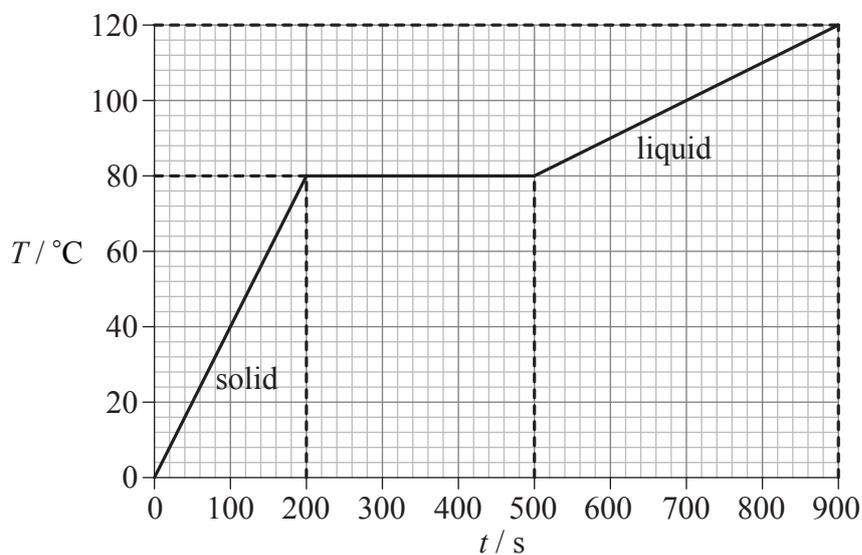
The magnitude of the force exerted on the skier by the tow rope must be

- I. greater than the magnitude of the total resistive force acting on the skier
- II. equal to the magnitude of the force exerted on the tow rope by the skier
- III. equal to the magnitude of the force causing the boat to accelerate.

Which of the above factors is/are correct?

- A. I and II only
- B. I and III only
- C. II only
- D. III only

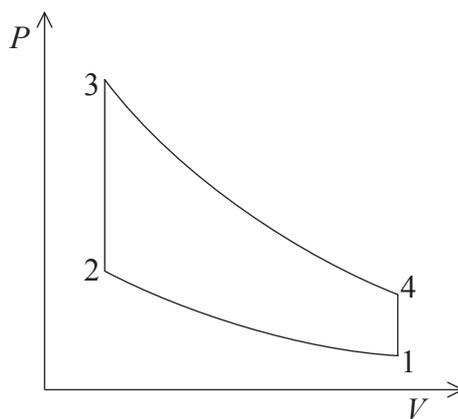
8. The internal energy of any substance is made up of the
- A. total random kinetic and potential energy of its molecules.
 - B. total potential energy of its molecules.
 - C. total random kinetic energy of its molecules.
 - D. total vibrational energy of its molecules.
9. Energy is supplied at a constant rate to a fixed mass of a solid substance until it starts to boil. The graph shows how its temperature T varies with time t .



What is the value of the ratio $\frac{\text{specific latent heat of fusion}}{\text{specific heat capacity of substance in the liquid state}}$?

- A. 20K
- B. 30K
- C. 40K
- D. 50K

10. The diagram shows a P – V cycle for a particular gas.



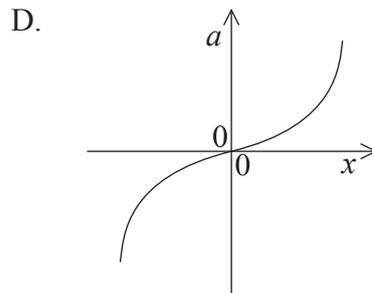
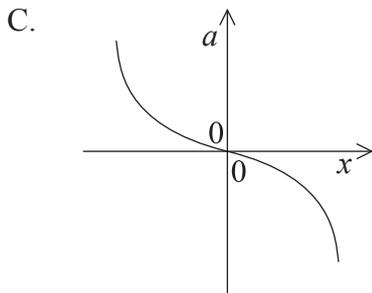
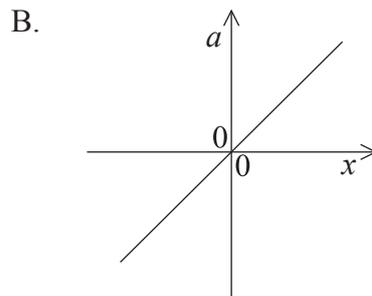
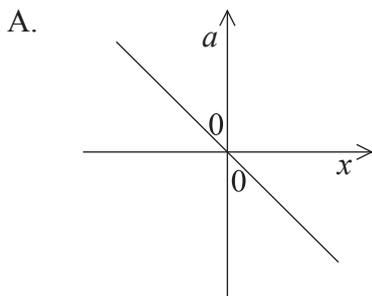
In which of the following changes is **no** work being done?

- A. 1 → 2
 - B. 1 → 2 → 3
 - C. 1 → 2 → 3 → 4
 - D. 2 → 3
11. An ideal gas expands adiabatically. What energy change is **true** for the gas?
- A. It gains thermal energy from the surroundings
 - B. It loses thermal energy to the surroundings
 - C. Its internal energy increases
 - D. Its internal energy decreases

12. Water in a container freezes. Which of the following correctly describes the change in entropy of the water and its surroundings?

	Change in entropy of water	Change in entropy of surroundings
A.	decrease	decrease
B.	decrease	increase
C.	increase	decrease
D.	increase	increase

13. An object undergoes simple harmonic motion. Which graph shows the relationship between the acceleration a and the displacement x from the equilibrium position?



14. Progressive (travelling) waves S and T have the same frequency and are in the same medium. S has amplitude 2.0m and T has amplitude 4.0m. What is the ratio of the intensity of T to the intensity of S ?

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. 2

D. 4

15. Waves emitted from sources X and Y have equal wavelengths and are initially in phase. The waves interfere destructively at point P, where the path difference is 0.60m.

X • • P

Y •

What is a possible value for the wavelength of the waves?

A. 0.20m

B. 0.30m

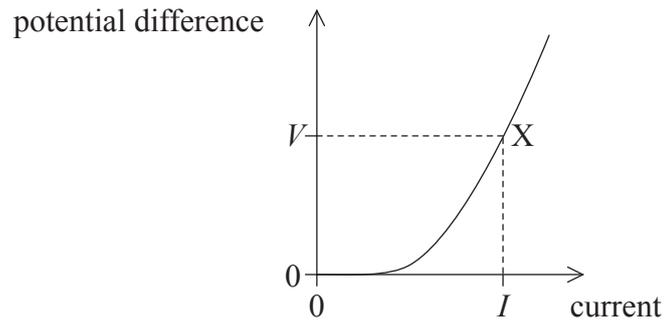
C. 0.40m

D. 0.60m

18. Unpolarized light is incident on the surface of a transparent medium. The reflected light is completely plane polarized. The refracted light will be
- A. unpolarized.
 - B. partially plane polarized.
 - C. completely plane polarized at right angles to the reflected light.
 - D. completely plane polarized parallel to the reflected light.
19. An electron has a kinetic energy of 4.8×10^{-10} J. What is the equivalent value of this kinetic energy?
- A. 3.0 eV
 - B. 3.0 keV
 - C. 3.0 MeV
 - D. 3.0 GeV
20. An ideal ammeter is used to measure the current in a resistor. Which of the following gives the resistance of an ideal ammeter and the way it is connected to the resistor?

	Resistance	Connection
A.	infinite	in parallel
B.	infinite	in series
C.	zero	in parallel
D.	zero	in series

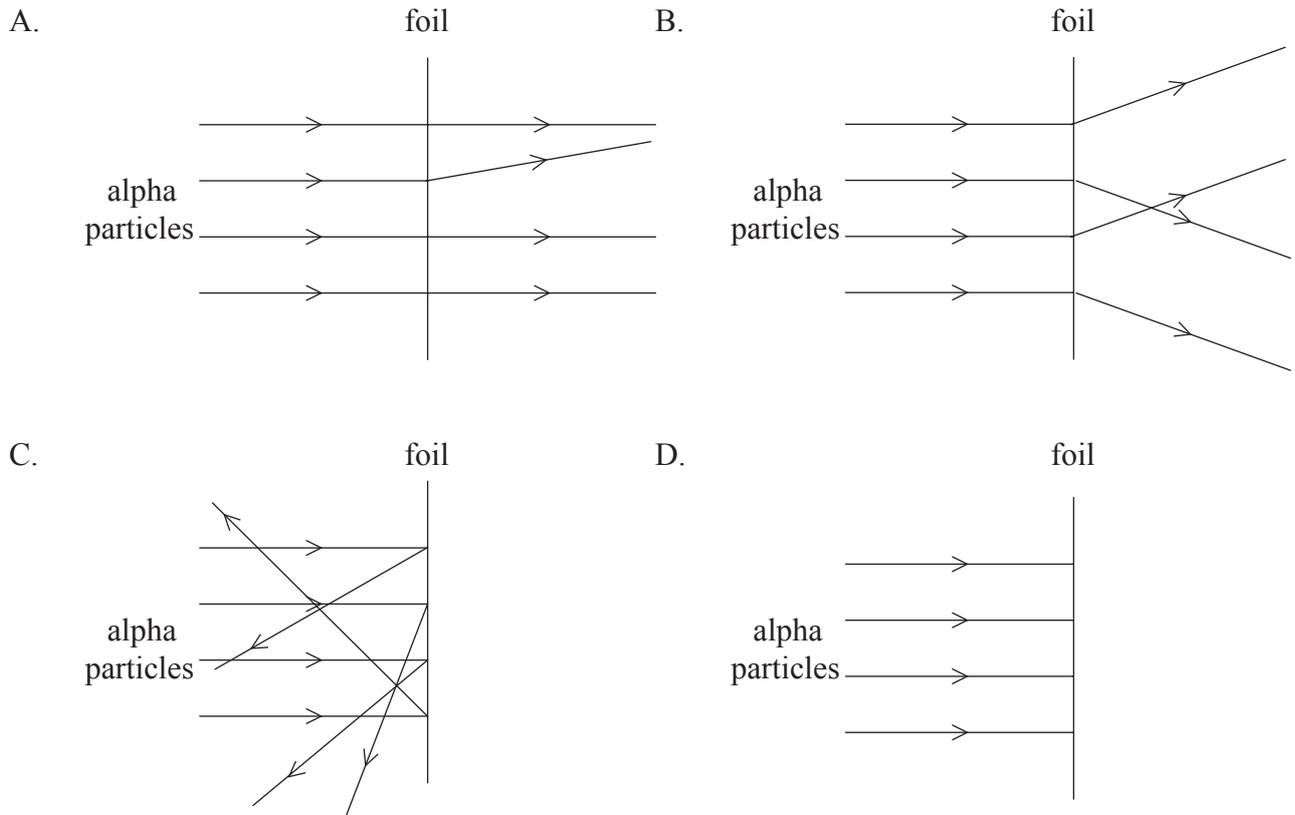
21. The graph shows the variation of potential difference across a device with the current in the device.



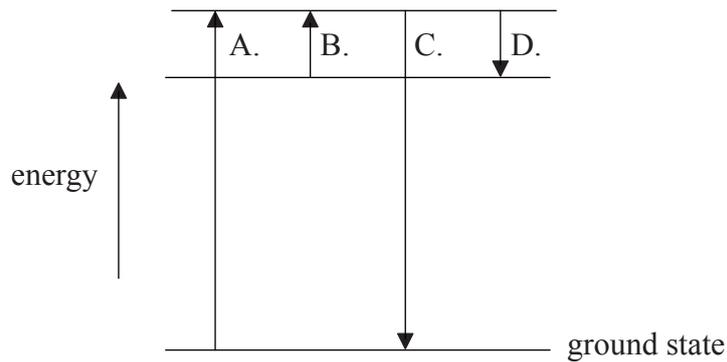
Which of the following gives the resistance of the device at point X?

- A. $\frac{V}{I}$
- B. $\frac{I}{V}$
- C. gradient of tangent to curve at X
- D. $\frac{1}{\text{gradient of tangent to curve at X}}$

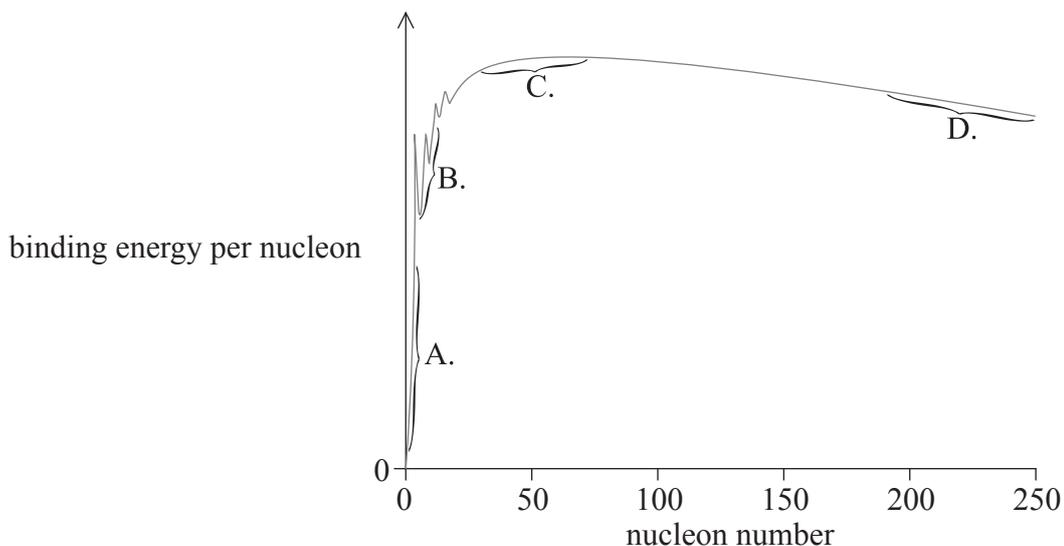
22. In the Geiger–Marsden experiment alpha particles were directed at a thin gold foil. Which of the following shows how the majority of the alpha particles behaved after reaching the foil?



23. The diagram shows three electron energy levels of an atom. Which transition results in the emission of a photon of the longest wavelength?



24. The graph shows the relationship between binding energy per nucleon and nucleon number. In which region are nuclei most stable?



25. For a black-body at absolute temperature T the power emitted per unit area is P . What is the power emitted per unit area when the temperature is decreased to $\frac{1}{2}T$?

A. $\frac{P}{32}$

B. $\frac{P}{16}$

C. $\frac{P}{8}$

D. $\frac{P}{4}$

26. The SI unit of surface heat capacity is $\text{J m}^{-2} \text{K}^{-1}$. Which unit is a correct alternative to this?

A. $\text{kg s}^{-1} \text{K}^{-1}$

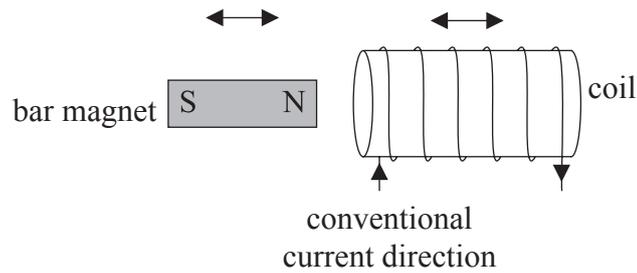
B. $\text{kg s}^{-2} \text{K}^{-1}$

C. $\text{kg s}^{-1} \text{m}^{-2} \text{K}^{-1}$

D. $\text{kg s}^{-2} \text{m}^{-1} \text{K}^{-1}$

27. Which of the following would **not** reduce the effects of the enhanced greenhouse effect?
- A. Replacing natural gas power stations with those using oil
 - B. Replacing conventional vehicles with hybrid vehicles
 - C. Replacing fossil fuel power stations with those using nuclear fuel
 - D. Increasing the use of carbon dioxide capture and storage
28. The centres of two planets are separated by a distance R . The gravitational force between the two planets is F . What will be the force between the planets when their separation increases to $3R$?
- A. $\frac{F}{9}$
 - B. $\frac{F}{3}$
 - C. F
 - D. $3F$
29. The acceleration of free fall of a mass of 2.0 kg close to the surface of Mars is 3.6 ms^{-2} . What is the gravitational field strength at the surface of Mars in N kg^{-1} ?
- A. 1.8
 - B. 3.6
 - C. 7.2
 - D. 9.8

30. A coil and a magnet can move horizontally to the left or to the right at the same speed.



In which of the following will a conventional current be induced in the direction shown in the diagram when both the magnet and the coil are moving?

	direction of motion of magnet	direction of motion of coil
A.	to the left	to the right
B.	to the left	to the left
C.	to the right	to the right
D.	to the right	to the left

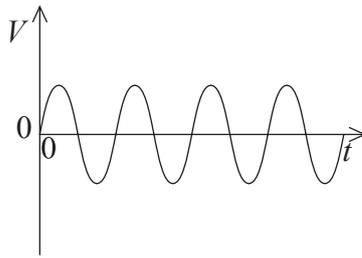
31. In an ideal transformer

- I. the power output exceeds the power input
- II. the magnetic flux produced by the primary coil entirely links the secondary coil
- III. there are more turns on the secondary coil than on the primary coil.

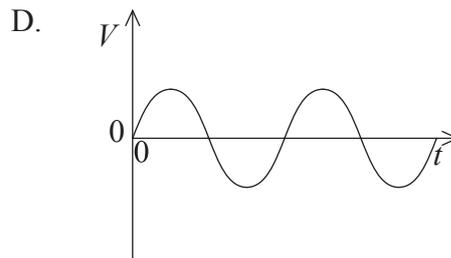
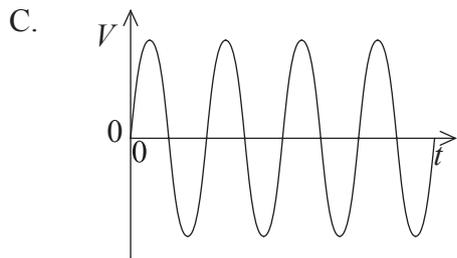
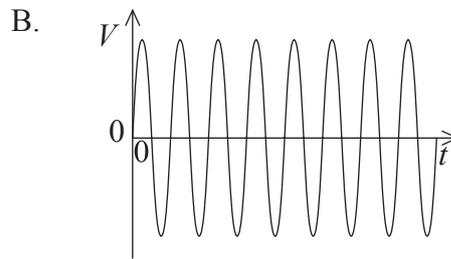
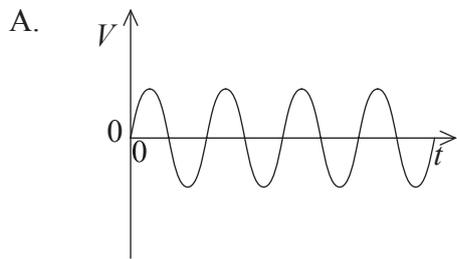
Which of the above statements **must** be true?

- A. I and II only
- B. I and III only
- C. II only
- D. III only

32. The graph shows the variation with time t of the output voltage V of a generator.



Assuming all graph scales are identical, which graph shows the output when the speed of rotation is doubled?



33. According to the Heisenberg uncertainty principle the quantity paired with momentum is

- A. time.
- B. energy.
- C. position.
- D. mass.

34. Photons are incident on a metal surface. Electrons are emitted from the surface. What single change may result in **no** electrons being emitted from the surface?
- A. Doubling the wavelength of the photons
 - B. Halving the wavelength of the photons
 - C. Doubling the number of photons incident on the surface per second
 - D. Halving the number of photons incident on the surface per second
35. Velocity selection in a Bainbridge mass spectrometer is achieved by the application of
- A. an electric field only.
 - B. a magnetic field only.
 - C. perpendicular electric and magnetic fields.
 - D. parallel electric and magnetic fields.
36. Evidence for nuclear energy levels comes from discrete energies of
- I. alpha particles
 - II. beta particles
 - III. gamma ray photons.

Which of the above statements is/are **true**?

- A. I and II only
- B. I and III only
- C. II only
- D. III only

37. Which particles are emitted in β^+ decay?
- A. Positron and neutrino
 - B. Positron and antineutrino
 - C. Electron and neutrino
 - D. Electron and antineutrino
38. Which denary (base 10) number is equivalent to the binary number 1001?
- A. 2
 - B. 4
 - C. 9
 - D. 15
39. The capacitance of a device is defined as the
- A. charge stored by the device.
 - B. energy stored by the device.
 - C. charge stored by the device for a potential difference of 1V across the device.
 - D. energy stored by the device for a potential difference of 1V across the device.
40. For a particular wavelength of electromagnetic radiation a silicon chip has pixels of quantum efficiency 80%. How many electrons are released when 500 photons of this wavelength are incident on one pixel?
- A. 1
 - B. 400
 - C. 500
 - D. 625